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Vol. XVIII, No. 5
November, 1961

INDUSTRIAL QUALITY CONTROL

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QUALITY through Scientific Methods

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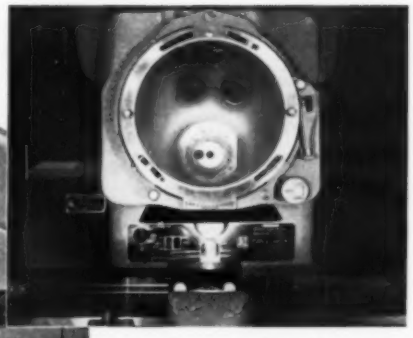

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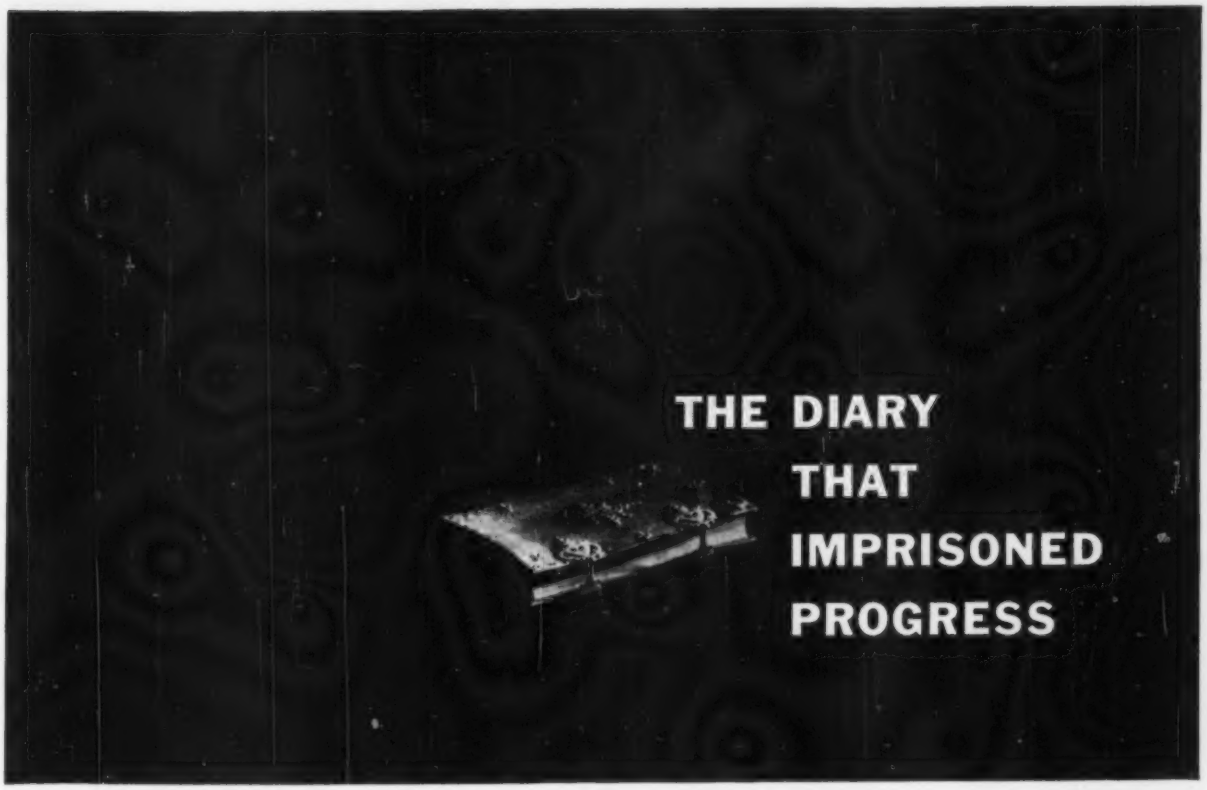

Nearly two centuries ago, Karl Gauss, "Prince of Mathematicians," kept a diary which was destined to become one of the most significant documents in the history of mathematics.

In his diary Gauss jotted down the results of elaborate calculations that had led him to fundamental discoveries in mathematics. But he never published these discoveries, and many of them remained undisclosed during his lifetime.

It wasn't until almost 50 years after Gauss's death that his diary was found and published. Much time and talent, meanwhile, had been spent in duplicating Gauss's efforts. Mathematical progress had been needlessly slowed.

In contrast, today's scientists and engineers are alert to the importance of sharing their findings through publication. In fact, the number of definitive papers published in a scientific or technological field has become a sure sign of the creative effort in that field.

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Status of the PROPOSED CHANGE-OVER To The Metric System in the United States

FRANK McGINNIS

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WHY DOES THE ISSUE of change-over to the metric system continue to be re-vitalized in the United States when, in every campaign to install it, the opposition has won? The answer to this question lies in the myriad of factors which must be considered. The fast-changing composition of international commerce, our own national metamorphosis into the nuclear age, the elements of expense, inconvenience and time, and an "inch" heritage all play a part in the outcome. The status today is that we are a long way from throwing the switch which will put in motion, officially, the mechanisms of conversion.

Many of the proposals for conversion seem so logical that one wonders at the hesitation. The metric system is part of the international language of science. World-wide exchange of ideas and meanings would be simplified as would the use by our scientists of foreign formulas and equations. At the present time, in our technical work, a great deal of time—estimated as high as five percent—is wasted by using units not having a constant system such as the metric system. For example, we deal with four sets of units for speed: aerodynamic — feet per second; aeroplane — statute miles per hour for some, nautical miles per hour (knots) for others; and kilometers per hour when expressing aircraft performance for international use. There can be little doubt that were we completely metric, our research would be advanced, our designing more consistent, and our manufacturing simplified.

By conforming with international measurements and being compatible with foreign hardware, our products for export would gain immediately in acceptance on the world market. Since 1920, many more countries have accepted the metric system—among them being China, Russia, and Japan. Great Britain and the United States stand virtually alone. Books and magazines employing metric terms are received more readily in areas such as South America. It is felt that the need for deciphering and conversion is a deterrent to the widespread use of American scientific literature in these countries.

Actually, we are not purely an inch nation. The value of the metric system has forced its inclusion in many areas of work. The Coast and Geodetic Survey uses metric units for base measurements and the United States mint uses metric weights for coinage. The electrical industry, to a large extent, uses terms and metric units recognized throughout the world. The pharmaceutical and chemical industries also find the metric system advantageous and have made virtually a wholesale change-over, bringing themselves within this structure.

Where an exchange of data on the international level is desirable, the American scientist, industrialist, and worker are faced with a translation of units. This presents the opportunity for error and increases cost. The proponent for a metric changeover presents a very strong case; but his goal—the United States acceptance of the metric system—is not a free gift. The path to the new system is expensive and strange.

ASQC LCS Code 700:00:000

Difficulties of Change-Over

Despite the fact that educators, scholars, and scientists have been solidly in favor of conversion, the huge majority of the American people own "inch" appliances, work with "inch" tools, and just do not think "metric." The problem of training and re-educating these people is formidable. A man who is six feet tall, weighing 200 pounds, cannot recognize himself as being 1.8288 meters tall and tipping the scales at 90.72 kilos. The carpenter working with "two by fours" will balk at using a "5.08 x 10.16." The housewife, needing a pound of chopped meat for her casserole, is not likely to settle for anything else no matter what it is called. The present adult generation of the United States is lost for the metric system. If we insist that conversion to the metric system is logical and realistic, let us realistically assign the learning period a value in years. Our schools and educators can instill in young people the knowledge and background necessary for a massive acceptance of a new way of life.

What It Would Cost

Forgetting for a moment the intangible mores, resistance to change, and habits of a people, we must face concrete and bitter facts. Buying a metric system presents a staggering bill. Initially, there must be education and following this immediately must come the replacement of charts, tables, handbooks, textbooks, blueprints, and company manuals. In the metal-working industry, and defense industries on the whole, this would be somewhat like transcribing the contents of the New York Public Library into Latin. Conversion to the metric system would make obsolete the performance data on items such as bearings; it would necessitate translation of material strength histories, and would make meaningless reliability and performance records on industrial components. These are pieces of paper and the costs involved would be in converting terms, repeating tests, and drawing new charts.

There is a larger and more disheartening cost. A metric conversion would demand the replacement of millions of dollars worth of measurement tools and instruments. Modifications or replacement of measuring tools including gages, laboratory equipment, test equipment, vernier tools, lead screws, and automated cutting tools, in one plant of one representative American manufacturing corporation is estimated at $1,800,000. Multiply this figure by the divisions of corporations currently engaged in producing jet engines, shipboard radar, navigational gyros, astro-trackers, and nose cones. Then add on this sum the cost of low productivity in all tasks while personnel proceed slowly as they learn the new system.

With a world at peace, the time, effort, and cost may not be judged too high for us to undertake when balanced against the ultimate result. In a period of depression, the metric change-over possibly might be an industrial panacea, employing our people, using our machines when otherwise they would be idle, and producing an end result which would benefit our future economy. A world at peace—an industrial depression. Unfortunately, we do not have the former, and fortunately, not the latter. Instead we are engaged in an economic race with Russia which will not allow the luxury of time. Most of our nation's advanced projects are on crash schedules. A metric change-over would make a shambles of these.

How It Can Be Done

All of the above does not negate the metric system for the United States, but it does dictate that any considered plan be a long-range plan. There are possible special applications. Individual "islands" of manufacturing effort can be initiated where new products or types may be engineered and manufactured completely metric. There are other possibilities but the "inch" spare part will be with us for our current operating items. The 1/4-20 screw will be available to the basement worker for some time.

Perhaps the most significant fact is that both houses of Congress have introduced bills to study the metric question in depth. If passed, Congressional committees will pursue avenues of value, cost, and feasibility. Their conclusions should be more meaningful than any one individual's viewpoint or prejudice. To some degree the Federal government already has investigated the problem. The National Bureau of Standards has gathered over 50 years of documentation on the subject and continues to collect facts from both hemispheres. Their conclusions have not been made known as yet.

Our inch and decimal system has produced 19 of the 23 satellites now circling the earth. Oil drilling pipe is measured in inches anywhere it is used throughout the world. We trade with other countries and they with us. Denied the metric system we will not close General Motors, Convair and Sperry Gyroscope next Monday.

If the metric system is to come to us it will come from a strong economic incentive rather than by legal decree. The cost of a new tool as compared with its value remains the single decisive factor.

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LOTTING

JOSEPH MANDELSON

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FOR MANY YEARS, it has been customary in production to form groupings of product on some fixed basis and call such groupings "lots," usually with a qualifying adjective reflecting the origin or purpose of the lot. To judge by the criteria customarily employed in making such groupings, the objective of lotting seems to have been quite obscure in many cases. Since lot identifying symbols are frequently placed on the item or on its packaging and some records are customarily kept of each lot and what went into it, it is easy to see that lotting can involve expenses which can be justified only by its objective and the degree of success in meeting it.

Lotting is commonly practiced in connection with perishable items or those of considerable value or importance. It is more usually employed in Government procurement than in industry. Particularly in connection with munitions, the lot is the basic unit in the periodic re-evaluation of the serviceability of supplies through inspection and test known as surveillance.

In the past, the term "lot" has been applied to several concepts, some of which are relatively unfamiliar and of no particular consequence to this discussion. However, most of these concepts are defined here to clarify relations among the different ideas involved.

a. *Contract lot* This term has been applied to the total quantity of material to be produced under a contract. Thus, a manufacturer may undertake a contract to produce a (contract) lot of a specified number of items (e.g., 5 million cartridges). This lot type is frequently identified by a contract number or code which may or may not appear on the packages or on the item itself.

b. *Shipment lot* This lot type refers to that quantity of material shipped at one time to the purchaser under a given contract. Obviously, it may constitute all or part of a contract lot. The shipment lot is a trivial concept and is mentioned only in the light of antiquated requirements that "each shipment shall constitute a lot."

c. *Manufacturer's lot* In terms of the principles presented here this lot type is the most significant. It may, on occasion, be equal in size to the contract lot. It should constitute the maximum quantity of material produced to

ASQC LCS Code 210;352:70:400

be and which will remain homogeneous with respect to quality even on prolonged storage. As such it can serve as the unit of storage, surveillance, and supply. Insofar as the item (or at least its package) carries any lot marking, it should bear the manufacturer's lot identification. In keeping with the requirement for quality homogeneity, the manufacturer's lot should be produced and inspected against criteria deliberately formulated to insure that such homogeneity will exist within the lot at the time of production and will continue in use and in storage. It will be found that when these criteria are properly assessed and specified, the problem of quality control will be simplified, permitting the contractor to build good quality and homogeneity simultaneously during the course of production. These criteria may suggest that a maximum manufacturer's lot size be specified, but more usefully, the lot size may be left indeterminate and be specified to contain all inspection lots (defined below) produced and accepted consecutively under criteria designed to insure homogeneity.

d. *Inspection lot* This lot type includes that quantity of material, represented by the acceptance sample, offered to the purchaser for inspection and test and subsequent acceptance or rejection as a whole. If this lot type is produced in a manner permitting heterogeneity of quality, it is plain that sample variability will reach a point where the interests of both producer and purchaser will be jeopardized. Therefore, the inspection lot may consist of all or only part of the manufacturer's lot, but it should *not* contain material from more than one manufacturer's lot. The definition of manufacturer's lot, given above, implies that a given manufacturer's lot is homogeneous within itself but possibly different from adjacent manufacturer's lots. Therefore, if an inspection lot were taken from more than one manufacturer's lot it might be heterogeneous. Since it is frequently but a segment of the manufacturer's lot, the inspection lot has also been termed the "inspection sublot."

e. *Proof-test lot* In certain kinds of Government procurement, the specification does not prescribe all tests required to reveal whether the material is satisfactory for issue and use because the producer may not be equipped to perform certain tests which alone can reveal significant quality aspects. Thus the definitive test for artillery shell consists of proof firing from a gun. Since the producer does not normally possess facilities for such tests, the Government customarily accepts such material subject to proof test. For this purpose the proof-test lot is normally specified as equal to the manufacturer's lot. On occasion a proof-test lot is specified to consist of several manufacturers' lots. This is unjustifiable for if such manufacturers' lots are not of uniform quality they should not be combined for purpose of proof-test. If they are uniform they should not be separate manufacturer's lots.

f. *Grand lot* The grand lot consists of a succession of inspection lots accepted individually and then subjected to statistical controls and evaluation designed to insure homogeneity, within specified limits, among all inspection lots made a part of the grand lot. This lotting concept has not received the attention it merits, due in part to lack of appreciation of the technical (mostly non-statistical) factors involved. Properly employed, the grand lot concept can extend the manufacturer's lot size to a maximum without incurring the inconvenience of rejection of large inspection lots. The practice of grand lotting can insure uniform quality, minimize the number of manufacturer's lots, act as a form of quality control, minimize customer complaints, and simplify and reduce lot marking and record keeping.

Purpose of Lotting

The basic purpose of lotting is to facilitate repeated evaluation and control of the quality of material by production to permit proper segregation and identification of homogeneous groups of material. The degree of control required will dictate the details of lotting criteria. If quality is of interest only when the material is inspected and accepted, no lotting procedure is required beyond the formation of homogeneous inspection lots. Under these circumstances, there appears to be no reason for permanent lot marking or record keeping. However, if the material is of such nature (e.g., ammunition, gas masks, etc.) as to necessitate periodic evaluation of its serviceability (surveillance), even after distribution, further lotting procedures are entirely justified and necessary.

Lot Homogeneity

Quality control literature mentions the fact that the lot should be homogeneous. Unfortunately the stress is placed upon the inspection lot. Little, if any, consideration is given the manufacturer's lot. In part, this may be due to the fact that the several lot types are not independent, but are interrelated in the manner indicated by the definitions already given. It is probable that, in large measure, the manufacturer's lot has been ignored because surveillance of the type which characterizes military material is not normally considered an industrial practice. Nevertheless, it is a problem both for industry and government.

In the commercial field, surveillance of items is accomplished by the user and unserviceability is brought forcibly to the attention of producer and distributor through customer complaints. Industrial guarantees of quality for stated periods after purchase amount to an invitation to the purchaser to conduct intensive surveillance on a use basis for at least that period of time. Many items characterized by such guarantees are serially numbered (lot size of one) or otherwise identifiable and in most cases of this kind manufacturing data covering production of these items are meticulously maintained in the producer's file.

Statistical quality control considerations suggest that the (inspection) lot be produced under one "constant set of causes" to insure homogeneity. In other words, all material produced under practically identical conditions should constitute the inspection lot. Any significant change in raw material, source of supply of a component, machine variation or breakdown, assembly technique or personnel, etc., would necessitate segregation of the product into another inspection lot. Close adherence to the "constant set of causes" as the lotting criterion normally results in formation of a large number of small inspection lots and subsequent excessive and uneconomical inspection and test. Furthermore, since the manufacturer's lot is frequently equated to the inspection lot, the multiplicity of manufacturers' lots so constituted provide an intolerable burden in supply and surveillance.

Insistence that lots be homogeneous with respect to a constant set of causes is proper. However, it

is apparent that this approach can be practical only if the constant set of causes is not all-inclusive but is limited to those factors essential to maintenance of critical quality characteristics at desirable quality levels. This principle is of even greater importance in defining the manufacturer's lot than it is for the inspection lot. It is desirable to maintain a constant inspection load and reduce to manageable levels the storage space allotted to manufactured material awaiting inspection decision. These factors tend strongly to limit the size of the inspection lot. Moreover, periodic in-process inspection and test to furnish the data for adequate quality control also requires that the size of the inspection lot be limited.

On the other hand, the manufacturer's lot, which bears the lot identification marking and is the natural unit for monitoring product quality after it has been purchased and distributed, should be as large as possible, containing a maximum number of inspection lots consecutively produced in a manner consistent with maintenance of homogeneity. In this way frequent change of lot marking is not required, the number of lot records is reduced, and the surveillance burden (where applicable) is limited.

Practically all of the useful purposes of lotting demand that the lot be homogeneous. This condition is essential to eliminate the heavy economic loss which frequently attends lot heterogeneity. To render this requirement operational, this question must be decided: With respect to what must the lot be homogeneous? Obviously the lot need not be homogeneous with respect to all possible quality characteristics; only some characteristics are important, some more than others. For example, bombs from the same lot may be painted, using different batches of paint, without in any way changing their similarity or homogeneity with respect to the one quality characteristic of importance, viz.; maintenance of functionability over an extended period of time. However, if the bomb fuses were produced by different manufacturers or by the same manufacturer under different conditions, it is possible that they might not have the same quality and/or storage characteristics. Hence, bombs assembled with such different fuzes are not ordinarily grouped together in one lot.

Critical Components

The conclusion is inescapable that lotting criteria must reasonably be founded upon those components whose quality is critical to the desired functioning of the item. If there are several such components, greatest stress should be placed upon those which cannot economically or safely be replaced in the end item, and whose deterioration may be expected to precede others in causing malfunctioning of the item.

A simple example for consideration is an ordinary high-explosive bomb. In general, there are four components which may be of significance in lotting: the fuze, booster, explosive charge, and the bomb body. If the bomb body is known to have been made in accordance with applicable drawings and specifications and these documents are known to describe an adequate component, the bomb body may be eliminated from further consideration. But if these conditions do not obtain, the bomb body may become a component of critical significance to lotting.

The fuze is normally less long-lived than either of the other explosive elements. Failure of any one of the explosive elements will cause a dud. The fuze, however, will be expected to fail first, hence it is a candidate critical component. Now, if on storage and subsequent fuze failure, the bomb fuzes could not economically be removed and replaced, the fuze would become the only critical component to consider, since after it becomes defective the bomb must be discarded. But if, as is usual, the fuze can be removed, it will be necessary to control the lot with respect to critical components other than the fuze.

The booster and explosive charge must be considered, in turn, as candidate critical components using the same reasoning as applied to the fuze. If the explosive material comprising the booster is known to be less stable on storage than the high explosive charge, then the former is the critical component. If some way of testing booster quality after storage exists, and the booster can be economically removed and replaced after failure is indicated, then the high explosive element must be considered the critical component. If any critical component has an expected life far beyond that of the anticipated useful life of the entire munition (in view of possible obsolescence of the munition, etc.), then, for all practical purposes, this component and all succeeding candidate critical components may be eliminated as lotting criteria even though in a technical sense one or more may actually be critical components.

It will frequently be found that a given part of the manufacturing procedure is critical in precisely the same sense as a component. Thus, control of a critical component may be effected by use of more precise machines, air conditioning, quality control procedures, etc.

In the case of the AN-M50 Incendiary Bomb, it was discovered that the first-fire mixture was the critical component. This material was found to be susceptible to moisture. Engineering and chemical considerations alone would have sufficed to reveal the critical nature of the mixture involved. The applicable specification prescribed the bomb lot to contain a stipulated large number (as many as 250,000) manufactured consecutively. The first-fire mixture, however, was not specified as the critical component. Consequently, it was not exceptional to find that when two bomb clusters from the same lot were tested after two to four years of storage, all the bombs of one cluster might function but none, or very few, of the bombs of the second cluster would burn. Since the test is destructive, serviceable clusters could be differentiated from defective material only by destroying them. Hence, since the defective material could not be identified and eliminated, the entire lot had to be declared unserviceable. The different deterioration rates of first-fire which caused this difficulty resulted directly from original heterogeneity in manufacture.

In this case, a proposal to confine a lot of this bomb to those manufactured containing first-fire mixture from a single mixing batch would be too restrictive. Safety considerations demanded that such a batch should contain only enough material for some 500 to 1000 bombs. Such a lotting plan, while correct in principle, is obviously impracticable.

The problem could have been resolved by requiring that a lot of bombs must contain first-fire mixture compounded from not more than one lot of each of the two major components of the mixture, provided that uniformity of

mixing of individual batches of first-fire from its components be controlled. To insure uniformity of the many mixing batches contained in such a lot (which could conceivably yield 10 tons of first-fire, equivalent to perhaps 2 to 3 million bombs, or 15 to 25 lots of the old size), it would be necessary to establish a suitable test and standard quality control procedures such that all mixing batches within the first-fire lot could be considered as comprising a grand lot, having been produced of the same materials and in a uniform manner. In this case the uniformity of mixing procedure is critical as well as the purity of the chemicals; therefore both must be controlled. If this were done it might be reasonably anticipated that when any part of the cluster lot became defective the remainder of the lot would also be defective and for the same reason. This would insure that no unserviceable lot would contain any substantial quantity of serviceable clusters intermixed with unserviceable material. Furthermore, consideration of the nature of the susceptibility of first-fire mixture to moisture, coupled with adequate chemical and engineering measures, might have prevented the observed short storage life of this munition.

The use of the manufacturing procedure itself as a critical element in lotting is almost always applicable to chemicals manufactured by a batch or unit process. It is, therefore, usually desirable to specify that a manufacturing batch of chemical shall constitute a manufacturer's lot. If the batch comprises a mixture of chemicals (such as first-fire mixture just mentioned), and it is desirable to insure uniformity of mixture, a suitable sampling plan, test, and an adequate quality control procedure should be included in the specification to guarantee the desired uniformity. Failure to recognize the critical significance of uniformity, particularly of mixtures, may lead to unfortunate results.

During the war a batch of boiler compound was accepted based upon analysis of a composite of three individual samples selected at random from the lot. The individual samples were mixed and the composite sample tested. The accepted lot, when first used in a ship in the theatre of operations, rendered the boilers inoperative. It was necessary to tow the ship to port. There ensued the difficult operation of warning other vessels stocking this lot, under radio silence in the war zone, and of substituting serviceable material for the defective lot. This difficulty was caused by lack of appreciation of the need for insuring homogeneity of mixture by means of a suitable test. In this case the critical element of the lot was mixture uniformity.

Frequently it is not necessary that a material be homogeneous. Consideration and recognition of this fact may lead to substantial economy. For example, when FS (chlorosulfonic acid-sulfur trioxide solution) is used as a smoke-producing agent, notable variations may be permitted in the proportion of active ingredient (sulfur trioxide) without undue variation in smoke quality or quantity. Furthermore, when filling smoke munitions, several drums of FS are poured into a receiving tank. The pouring action results in mixing adequate to reduce any variations in composition of the contents of the several drums. Consequently this mixing or blending of FS prior to its use in production permits the establishment of large lots of field munitions. So long as FS meets specification requirements, there is no limit in principle to the size of the lot of field munitions. Nevertheless, during the war, the FS specification required that each drum in the lot of FS be separately sampled and tested. Unlike the previous example of boiler compound, a composite sample representing the entire lot of FS would have sufficed because within-lot variability is not disabling. This would have substantially cut the testing required. It is noted in passing that the war-time specification has been revised along these lines. In addition, a lot of FS field munitions was defined as all munitions filled from a single lot of FS. The reason for this stipulation is particularly obscure in view of the then existing requirement that each drum of FS be tested.

The establishment of critical components as the sole criterion for formation of manufacturers' lots can frequently be achieved through engineering considerations, based on technical knowledge regarding the expected life of the components involved, the feasibility of replacement of the defective components, and the economics involved in such replacement. This emphasizes the need for providing means for recording such technical information on a long-term basis in order to furnish a background upon which lotting criteria for new or modified items may be established.

Lot Records

If it is decided to use lotting as a means to permit closer control of the material in terms of the objective of issuing or selling only material which meets prescribed quality standards, then it is only common sense to do all things which are necessary to realize this objective. Merely to lot, even correctly, is insufficient—a permanent record must be kept of the lot to include an identification of each major component, especially the critical ones, an indication of the documents or standards governing acceptance and surveillance, all results of acceptance and surveillance inspection and test.

In short, in addition to lot identification data, a complete quality history is kept. These records, faithfully maintained and as complete as practicable, can be invaluable, not only to permit evaluation of the quality of the lot in question, but as part of the total data on all lots of the item, can furnish important information relative to the quality of the item as a whole and of its components. Thus, it was possible for us to learn that a certain fuze had an average serviceable life in storage of about five years, but when assembled into a certain grenade the average serviceable life was cut to three years. Obviously, such information has suggestive value to design engineers leading to product or component improvement. Sometimes a qualitative description of malfunction wedded to quantitative information will indicate the exact mechanism of the difficulty and permit elimination of causal factors. In short, when considerable quantities of information are available regarding a given lot, or all of an item, much of value lies encased in the matrix of the reporting system such that the more carefully it is designed and executed, the more diligently the personnel concerned with it are trained to use it, the more of value may be garnered from it. Not only are the immediate objectives of lotting realizable from such a system, but other worthwhile results are obtainable with just a bit of probing beneath the surface. The data are there; use them to the full.

Two MAGIC Words

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SOMEBODY once said that there is nothing more obnoxious than the constant repetition of the unpleasant truth. This annoying but necessary condition is the role demanded of the quality control function in any defense plant by two magic words, "Corrective Action." There is one major difference in the operation of an industry making material for the military and one making commercial items. In the latter the sales division represents the customer, in the former the customer is right there in the plant. Strange as it may seem, the military does not define in detail the method of operation of any of the manufacturing functions except quality control. This phase of the industrial cycle is defined in minute detail; in fact, the Military Specifications are incorporated into the contract. These specifications are many; they are completely comprehensive, and what they might miss in detail, they cover by blanket statements. Regardless of the type of Quality Control Military Specification referred to in the contract, one paragraph is common to them all. That paragraph is headed "Corrective Action."

To anyone who has been in quality control for any length of time in an industry producing for the military, one inescapable fact must have become apparent; the military is not interested in a defective part as much as it is interested in the system which produced the defective part. This being so, and since the military demands corrective action from quality control alone, it must be obvious that quality control is placed in an awkward position. If the system which produced defective material has to be corrected and quality control must see to it that it is corrected; it is possible, in fact, sometimes mandatory that quality control go so far as to insist on changes in management organization and company policy. Fortunately, in most cases, top management in this type of industry understands the situation and handles the condition intelligently. Sometimes however, a plant, for various reasons, falls into some of the pitfalls which trap the unwary. When this happens, it is usually because the group which makes up the higher level of the chain of command has either no knowledge of, or respect for, the consequences of ignoring the mandatory nature of this corrective action requirement. In a general sense, management in our defense plants falls into three major categories:

First, that plant which is blessed with all its top personnel having had long and immediate experience in dealing with the military

Second, that plant in which some of its management has had this experience

Third, that plant which has never before had to produce under military surveillance.

Regardless of which of these three conditions prevail, management must, repeat must, face up to this spectre of corrective action. They can meet the challenge the easy way by familiarizing themselves with the requirements and anticipating the military, or the hard way by having the military force them into line.

Let's look at some of the pitfalls. Some may be news to the uninitiated, but to those familiar with them they will probably be

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a source of amusement in retrospect.

The Empire Builder

Usually when staffing a new plant or when augmenting the staff of an old plant to produce for the military, top management will make sure that it has at least one man with the proper background or hires one. Almost invariably, especially if it starts with one man, he will be a quality control man, either a quality control manager or a chief inspector.

So now they're in business and away they go. Everybody pitches in to do the very best they know how in the way they have always done things, but when production control wants to move parts, they ask the quality control man first; when industrial engineering wants to revise process sheets they show them to him; when product engineering wants to change designs they confer with him; anybody who wants to do anything waits until he O.K's it. For a while; then two things happen.

First, because this poor character is only human he gets accused of being overly impressed with his own importance. He doesn't *go* to meetings any more, he *calls* them. He waits just a little longer each time before approving whatever it is he is asked to approve. Because his is the only and best contact with the military, he imagines this somehow puts him on a separate plane from the rest of management. In short, he has become an industrial log jam and socially impossible.

Second, when this poor benighted quality control man goes to the other departments — production control, manufacturing, engineering, etc.—for the corrective action he needs, they become less and less inclined to co-operate.

Teamwork

Probably no other word in the industrial vocabulary is as much overworked and as little understood as "teamwork." Let's imagine that it's the seventh game of the World Series. The score is tied; it's the last of the ninth; one out and a man on third. The batter lobs out a blooper to short center. In order to make sure that the center fielder catches the ball, every man runs out to help him. He catches the ball and the man on third walks home. This is teamwork? Every man but one left his position. The same thing can happen when a lot of defective material is produced or what is worse, actually shipped to a customer.

Remember, we said that the military feels that the best way to avoid a recurrence is to find the hole in the system and plug it. So in order to do this, a meeting is called. Immediately pandemonium reigns. Production has the idea that the best defense is a strong offense so it starts screaming that the product engineer has over designed the thing to begin with and that nobody could hold those tolerances. They're now engineers. Industrial engineering blames the budget people for not giving them enough money to tool for the job. This naturally gives production another crutch and they switch from product engineering to industrial engineering. Product engineering blames production control for not incorporating the last print revision and for not getting it to the floor on time. They are now in the production control business. Of course, it never occurs to anyone to ask quality control how it happened to miss the defect in the first place.

So everyone is out of position and the corrective action, if any, is weak and meaningless.

It'll Work, Let's Use It

This one is a real blaster. If there is one phrase that can snarl things up, it's the statement, "It's functional."

Let's face it. There are two major categories into which a defense item can fall. One which has been developed into a production phase and one which has not. We are not here considering those items which have not been transposed from the research stage to regular production because, obviously, the engineer in this case is still in absolute command. To attempt to combine the transposition with production methods would be patently ruinous and chaotic.

So let's consider the product which everyone agrees is to be run with the regular production methods and controls intended to be permanent. All the blueprints, schematics, diagrams, test specifications are finalized, signed by company engineering and accepted and signed by the military. At this point, it will be well to remember that the contract calls for material produced to these currently accepted documents, period. The military liked the product and its design; that's why they placed the order to begin with.

So production begins and as long as manufacturing has no trouble producing parts exactly to the specifications, everybody believes wholeheartedly in the philosophy "make it like the print." Then a part or assembly is produced which is just a shade outside the limits and is rejected. The first impulse is to scrap the lot of parts or the assembly, but then the dollar sign goes up and a product engineer is called in. He looks at the item, the blueprint or specification, the mating part and utters for the first time those shattering words "it's functional, let's use it."

A reasonable statement; economically feasible and completely commendable, but industrial cancer has set in.

The first result of this is that when quality control goes back for a corrective action statement, it is given with tongue in cheek. Sure, nobody wants it to happen again, but if it should, why get excited. The engineer bought it once, he'll buy it again, as a matter of fact, he'll have to, or look like an idiot. The production foreman makes a statement as his corrective action that he will "instruct the operator" in performing his operation. The more he thinks about it though, the more he is convinced that the defect was caused by bad processing, bad tooling, bad inspection, or the factory's elevation above sea level. Industrial engineering solemnly swears that they will change the process, rework the tooling, and personally bird dog the operation. On their first, and sometimes it is their very first visit to the operation, they get into an argument with production and come away firmly convinced that these knotheads would foul it up no matter what changes were made, so they don't change anything. Besides, the parts work, don't they? Meanwhile Mr. Quality Control is fat, dumb, and happy in the pipedream that he has achieved corrective action until the next time the item is made.

The firm is in trouble to the degree to which this condition is allowed to grow. Items produced so far out of tolerance that they are obviously scrap will automatically push a panic button which will immediately guarantee posi-

tive corrective action. But if a great many different items are produced just a little out of specification and are continually accepted as functional by engineering, some grave doubts are created about the accuracy of the designs originally submitted for Military approval. This is a hard statement, but that's the way it is.

Quality Control Has Too Many People

Every quality control man has heard this old war cry for as many years as he has put into the business. There are many and varied arguments to support the statement and at first glance they all seem reasonable. But let's examine the situation.

The most hackneyed statement is the old saw, "QC has ten percent of the personnel of the Shop," or "QC has one inspector for every eight production people," or "The QC budget is equal to six percent of sales." This credo faded out when we started to build the first supersonic plane and completely dissappeared with the first guided missile.

To be completely realistic, there are only two things which can be used to determine the number of people required by quality control. First, the degree of sophistication of design and second, the quality actually being produced.

Let's consider the first one — sophistication of design. There's not much to be done about this. In this modern missile era of highly advanced electronics and minaturized hardware, every assembly and every detail component requires inspection and test far beyond anything known in the past. Since we are in a missile race and schedules are important, we have only one way to get the job done; more people with more and better techniques. There is no point in bemoaning the fact that the inspection or test department is growing so large, that's the way it is going to be.

The factor of the quality actually being produced is something that is not new. To present an exaggerated example: If a machine shop employs a hundred men, all of whom are producing defective parts, it might be necessary to have an inspector for each machinist. In fact, if the parts are produced fast enough, it might conceivably take more than one for one to screen the parts. Obviously, as these men begin to produce better parts, the confidence level rises and sampling can be introduced, thus permitting a reduction in the inspection personnel. Since the inspector cannot do anything physical to improve the quality, it is axiomatic that the poorer the quality the more inspectors. If the passing of time does not show an improvement in the quality produced, it can only be concluded that the contractor is not capable of producing the parts. Rough, yes, but once again, the unvarnished truth.

If in either or both of these instances the inspection department is understaffed, defects are very likely to be overlooked. When these defects are reported inspection is concentrated on them which is a good effective corrective action, but meanwhile other parts are neglected and more defects are allowed to slip by than before. The condition pyramids and finally panic hits the inspection department.

Quality Control or Production Control?

Anyone who likes his job and is earnestly concerned about the success of the company he works for will have a natural desire to do anything he can to help bring about its success. It will probably be admitted that if an item is not shipped on time or not shipped at all the producer is a long way from being successful. Sometimes a quality control man is blinded by this natural desire to the point where he can't see the forest for the trees.

When this happens he has a tendency to go schedule happy. Now about the only way that quality control can affect schedule is to take more time than necessary to inspect or test a given item. If this happens quality control should indeed take a good look at its techniques and personnel.

However, the eager beaver thinks he can do things above and beyond the call of duty. He switches inspectors and testers back and forth; he suddenly decides that major defects have become minor; he is inclined to minimize reports which show a declining quality trend and in general relaxes the control he should exercise in order to move parts. He is called to shortage meetings and apologizes for parts which are "held up in inspection or test."

Gradually all this has a demoralizing effect on the quality control organization. The supervisory level becomes confused and the inspectors and testers become frustrated. Moving parts has become of prime importance and quality secondary.

Another outgrowth of this is that quality control is forced to try to persuade the Military Representatives to buy the defective parts because they are functional. So instead of a buying agency, quality control has become a selling agency.

Finally because quality has become secondary, defective parts are actually shipped. However they are promptly returned by the user, so where is the all important schedule now.

Quality Control + Reliability = Zero

There have been volumes published on the subject of the relation of quality control and reliability and vice-versa. Their functions and the degree of overlap is usually interpreted and defined by management. One major consideration can be overlooked and that is responsibility for control of production.

In this day of continuous basic research in the field of guided missiles many new systems are put into production each year. It is ridiculous to suppose that every design for every system is perfect. So no one should be dismayed when a system is found to be unreliable usually because of a component called out in the design. The important thing is to face up to the situation and stop the production immediately. The question is — who does the stopping?

In an organization where this responsibility is not clearly defined quality control and reliability might be like two men standing over a bomb; each waiting for the other to pick it up and throw it away. Quality control feels that since through engineering investigation reliability has determined that the item is doubtful, reliability should assume responsibility for stopping its production.

Reliability on the other hand feels that they are an engineering function and after determining that the item could fail to

function their job is done. So no decision is made and the item is produced until the Military steps in and stops it.

All of the conditions portrayed thus far are systems situations. Corrective action involving nothing more than a tool change or a process improvement are elementary and not too difficult to accomplish. But a change in management outlook or a complete reversal of basic philosophy is usually a tough nut to crack.

Too Much Paperwork

Every military contract requires two basic forms of paperwork. This paperwork of necessity can and usually does become burdensome and any contractor who objects to the detail involved in handling such documentation would do well to stay out of the military procurement business.

The two general types required are those covering accountability and those required of quality control. In its application to corrective action the paperwork necessary can expand in relation to the quality produced and the number and type of customer.

In an attempt to show in writing that action was taken to prevent the recurrence of a defect, quality control must design and use a document which has a block to be filled in with the corrective action statement. From this document sometimes springs associated documents which must be used. In no time at all a howl goes up from everyone, "Too much paperwork." Everyone except quality control; they're stuck with it. So everyone goes on a paperwork binge. Especially those who have little or no connection with it and no responsibility for it. This form and that form is deleted; in the process confusion sets in, and corrective action takes second place to what is supposed to be a drive for efficiency.

Conclusions

By the use of perspicacity, honesty and courage, everyone concerned with producing acceptable parts can contribute to getting the corrective action job done. Perspicacity will differentiate between things as they are and as they should be. Honesty will admit they should be changed. Courage will change them no matter how drastic the means necessary to do it.

Integration of Quality and Reliability Functions

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IN THE PAST FEW YEARS Quality Control people concerned with our military programs have stated that they could see no reason for having separate reliability organizations or functions. It was felt that reliability was merely another design parameter, and as such was the responsibility of engineering since everything that needed to be done to obtain a quality product was well within the scope of the existing quality engineering function. One can only conclude from these observations that quality control people have become jealous of their position in the field and resent the encroachment by this new up-start called "reliability." Perhaps they feel that some of their objectives are being stolen from them. In reality, they are being enhanced. It has been evident that workshops and seminars held on reliability

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and quality assurance programs were well attended by quality control personnel. They were interested in increasing their obvious lack of information on reliability. We have only to note the success of the National Symposiums on Quality and Reliability which have been held every January for the last half-dozen years. The tremendous number of highly competent people who attend this symposium plus those who read its proceedings indicate that the subject is important to them and that quality and reliability have much in common. Industrial engineers, statisticians, mathematicians, electronic engineers, electrical engineers, and mechanical engineers are all participating with mutual understanding while complementing each other's efforts. Further, whether they are called quality engineers or reliability engineers, the professional stature of the people engaged in this work is certainly growing by leaps and bounds.

What led to the growth of this new, less-understood function of reliability? Much has been written about "quality control" in its role as monitor from the "cradle to the grave," i.e., from the inception of an idea to its use by the customer. The "reliability" function has germinated and grown simply *because the "quality control" function failed* to satisfactorily cover the whole program within this "cradle to the grave" area. It has been and is still sorely remiss in the pre-production area.

One answer to this problem is that the quality engineer should inject himself into a program early in the development design phase so he can make his contribution during the paper design stage rather than just during the testing or hardware stage. Auditing of the manufacturing, testing, and procurement feasibility does *not* seem to be *thoroughly* accomplished by the quality control organizations early enough. Note that "procurement" is also considered. The availability of realistic component specifications, as well as test specifications and test equipment, is becoming increasingly important. The receipt of components and materials in production quantities is not enough. They must be *usable* in order to meet production schedules. Mutual understanding and appreciation of part specifications as well as compatibility of test and inspection equipment and procedures is a must early in the development program. Engineers have been reluctant to accept quality control auditing or assistance, with its stigma of standardization during the development or creative phase of a program. Fearful of being stifled in his creative thinking the engineer has been reluctant to accept controls or advice; however well

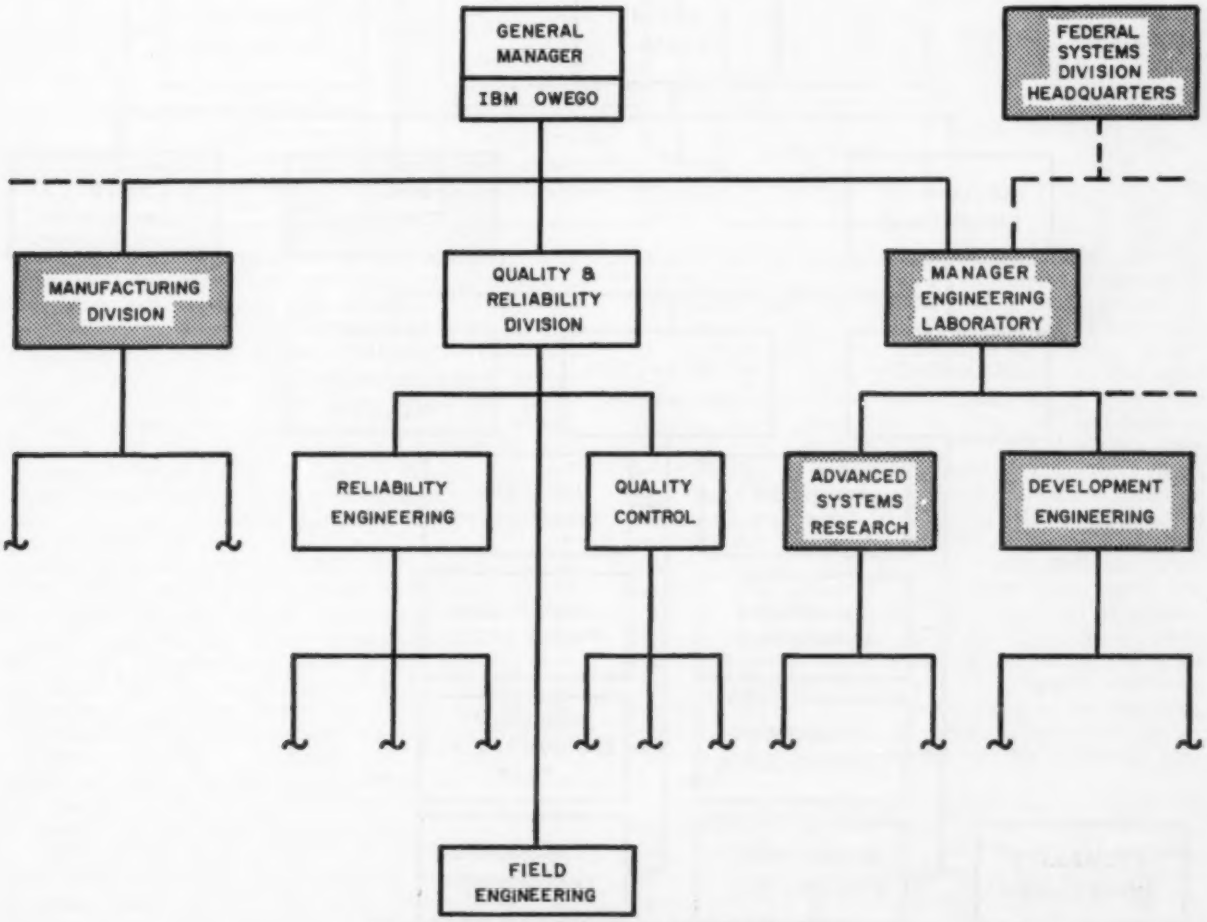


Figure 1—Quality-Reliability Division Organization

meaning. Perhaps it is also possible that the quality people have erred in not supplying the proper caliber of people to work with engineers.

If the quality engineer had previously been part of the design engineers organization, actually doing and being responsible for engineering design decisions, it would appear probable that they would have the respect and confidence of their fellow engineers and would have little trouble in providing unsolicited assistance.

This ability to gain acceptance by an organization or group which is in effect a service organization needs to be given considerable attention. It is recommended that such a type of service group originate and be developed within the engineering organization. Subsequently, however, it should be put under independent management to provide not only assistance and guidance but an *unbiased* monitoring or auditing function. Such a function should emphasize the interest and operation of the group during the development or pre-production cycle. It would be reasonable to assume that they would likewise be very interested in the end use result and not necessarily with the production phase alone. We can safely say then that the two phases in the life of any program are equally important — the pre-production phase and the production phase. Both need complete and important attention. Both need professional engineering type of people with proper engineering thinking.

We are just beginning to place the proper emphasis on quality during the pre-production programs. The growth or requirement of reliability functions* has resulted from the *failure* of the quality operation to completely cover the pre-production phase.

This "failure" is not necessarily unexpected. It is recognized that the inspection and quality engineering operations have been very naturally associated with production programs. Consequently, there is always the threat of emergency or "fire alarm" demands being placed on their efforts and time to solve production bottleneck problems. In addition, considerable effort has been directed toward the prevention of production rejects rather than something that was started and effective during the development aspects of an engineering program. The "polishing up" of a development program is generally conceded to be an engineering responsibility and is handled by product or production engineers.

*For example, Dr. Mettler's report on Bombing Navigation Systems early in 1955 recognized the improvements that had been made in accuracy, range, and capability of Bombing Navigation Systems. The newer equipments were larger, more complex, and wonderful in performance *when they were operating*. However, experience proved that they were working less frequently, in other words, malfunctions were increasing. The equipment was becoming less reliable. This report aroused the Department of Defense into action with the result that emphasis on reliability has taken place ever since.

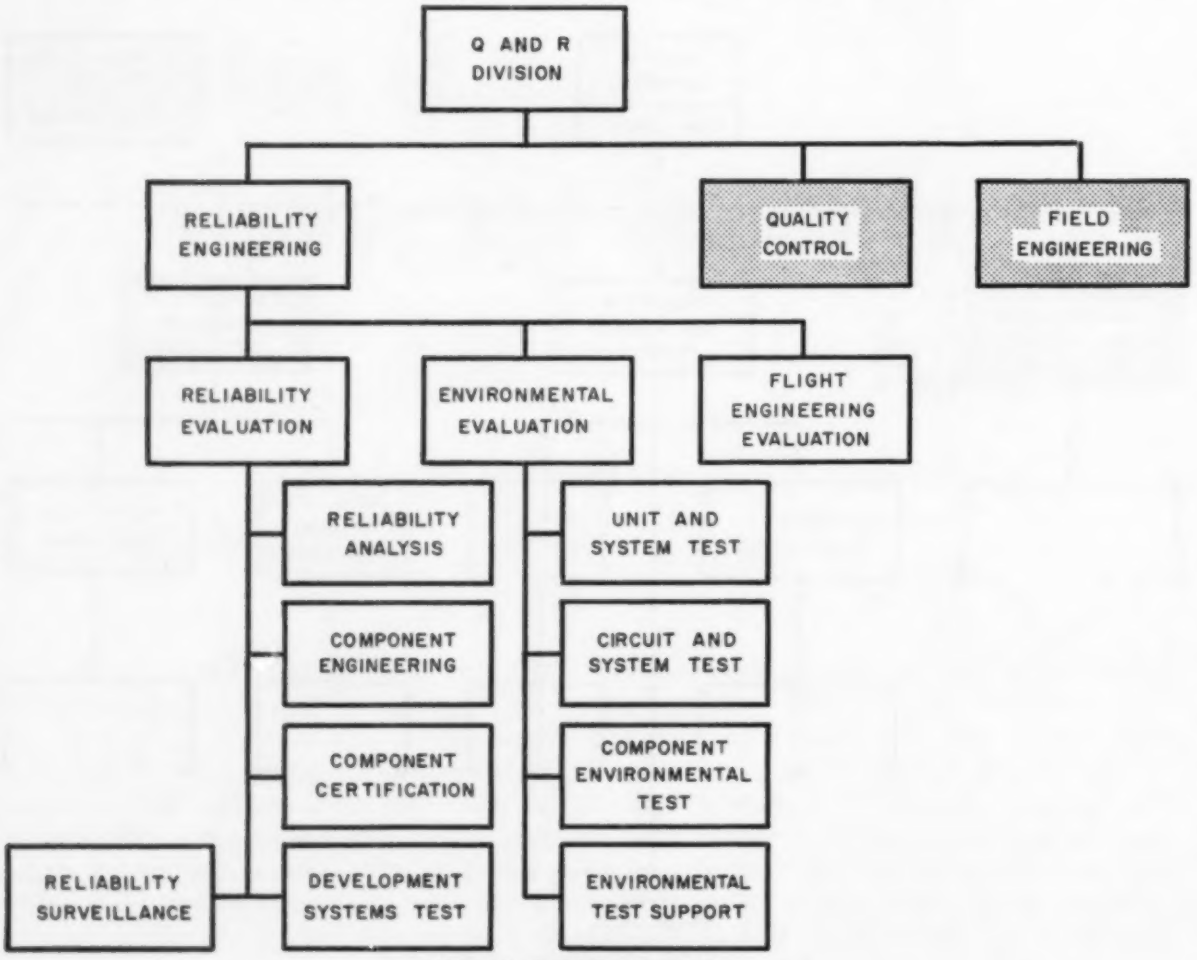
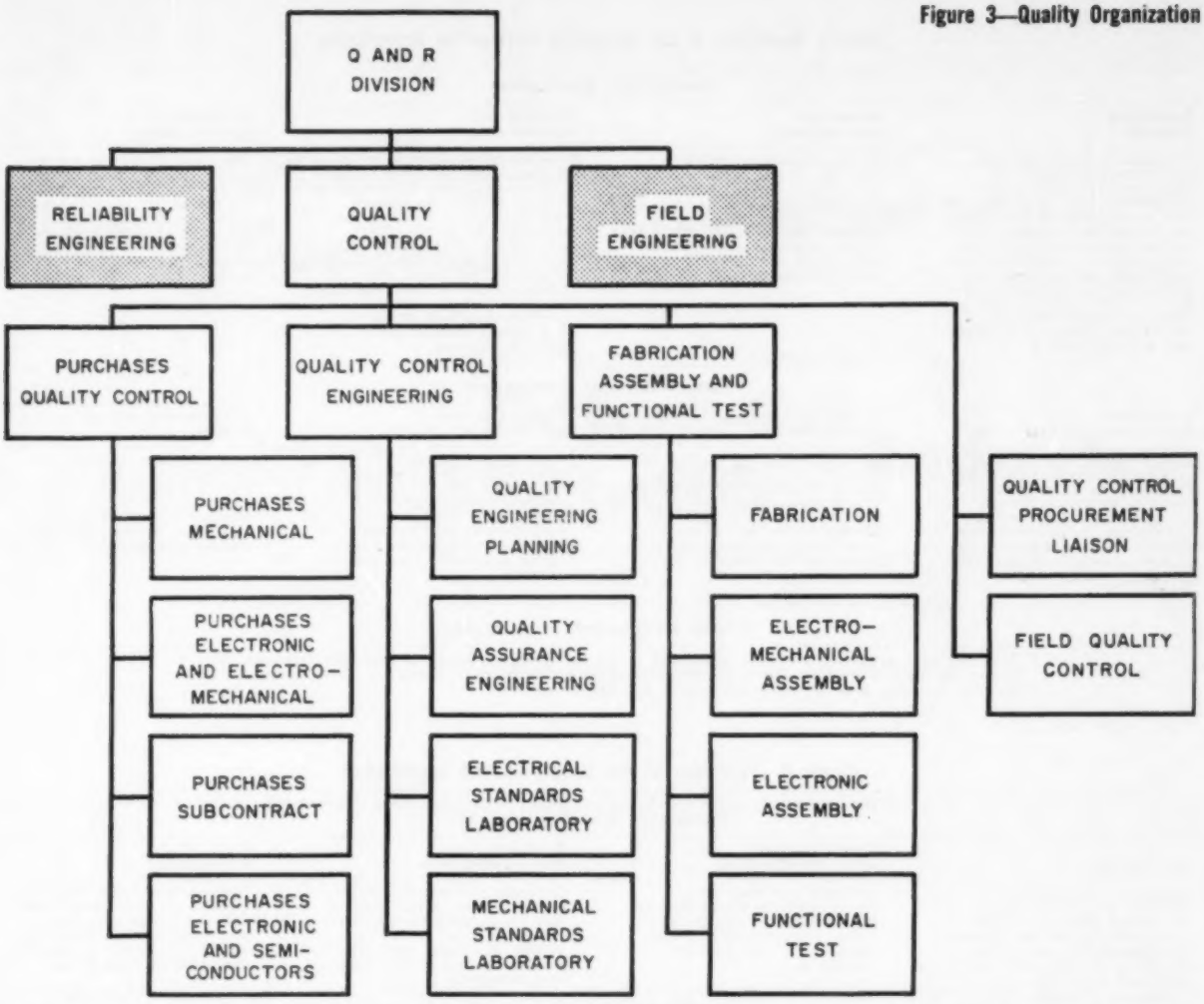


Figure 2—Reliability Organization

Figure 3—Quality Organization



Since numerical reliability requirements such as mean-time-to-failure are now specified in contracts with firm delivery dates, it is essential that reliability assurance programs be established early in the program. We can no longer wait for the hardware and test phases to determine equipment quality and reliability. Over the years there has been considerable argumentation as to whether reliability can be measured, but, this is no longer subject to conjecture. It is measurable! Quality control has had much success because quality is measurable. Therefore, "reliability" should be made a *specific* important function.

The integration of reliability and quality control, with each having the same primary objective, should be accomplished for a most effective program. One important by-product of this integration is the control within a single function of the professional people involved. The resulting ease of transfer from one type of operation to another would benefit the individuals involved as well as the operations of the particular functions. A great deal of mutual respect for each other's responsibilities and activities can be engendered to ultimately result in an appreciation of the total quality picture.

IBM, whose equipment is primarily leased and maintained, certainly has recognized the importance of long, trouble free operation to the customer. So, too, would a corporation like AT&T. Regardless of how good equipment performance may seem — we must recognize the need for improvement. An integrated quality and reliability operation provides additional assurance of monitoring performance.

Consider the organization and implementation in the IBM facility at Owego, N. Y., which is engaged only in military products work. In the type of organization layout shown in Fig. 1, these two functions have been kept separate, and yet because they have an identical basic primary objective, they are identified as part of the same organization. Here, reliability engineering and quality control are integrated in a complete function which reports directly to top management at the same level as other major functions such as engineering and manufacturing. The accompanying charts also show the breakdown to the department level (first line management). In addition, other charts show in detail the functions of each area. This detail is essential because certain descriptive terms mean different things to people in other organizations. In this way, a clear understanding of what is involved under each function or department can be definitely understood.

In summary, while manufacturing is responsible for building a quality product, and engineering is responsible for the quality of the design, the quality-reliability division operates as a service organization for each with the responsibility of auditing the design and production operations and of assuring corrective action.

Table I—Functions of the Reliability Engineering Organization

Reliability Evaluation

Reliability Analysis	Reliability Surveillance	Component Engineering	Development Systems Test
Provides a comprehensive analytical evaluation of equipment reliability obtained through: development and application of reliability prediction techniques; reliability test planning, control, and analysis of systems, subassemblies and critical component parts; reliability design review; over-all planning and monitoring of reliability programs of IBM and subcontractors.	Accomplishes statistical analysis of field reliability and maintainability data. Operates field failure reporting system to provide service-life coverage of in-use equipment. Provides data to all concerned activities for action.	Assists design groups in selection and application of component parts. Certifies all non-standard components and issues specifications on usage limits. Advises WSC and USAF on selection, application and standardization of component parts. Performs component part failure analysis and recommends corrective action on all R & D and selected production failures.	Tests and evaluates all development model units, assemblies, and equipment for reliability, maintainability, accuracy, and operational stability. Evaluates all engineering changes for effect on system.

Environmental Evaluation

Component Environmental Test	Circuit and System Test	Unit and System Environmental Test	Environmental Test Support
Environmentally tests all component parts considered for use. Provides advisory services to design groups on special environmental conditions. Requalifies component parts by performing environmental and life tests as requested by Quality Engineering.	Accomplishes life testing of circuits and subassemblies under simulated operational conditions. Provides information early in system design stages on component application and performance of design under dynamic conditions.	Accomplishes environmental tests on all units, assemblies and equipment to appropriate specifications. Accomplishes environmental tests on subsystems and systems. Performs reliability tests on systems.	Procures and operates all environmental test facilities and equipment. Designs and fabricates special test equipment. Supports operation of other environmental test groups.

Flight Evaluation Engineering

Modifies test aircraft for use as electronic test beds. Designs, develops and fabricates instrumentation for data collection. Tests installed systems for reliability, accuracy and operational suitability. Reduces and analyzes data from system under test.

Table II—Functions of the Quality Control Organization

Purchases Quality Control

Mechanical	Electronic and Electromechanical	Electronic Semi-Conductors	Subcontract
Inspects cast, machined, molded and formed parts, hardware items, and raw materials. Facilities include Bearing and Optics Labs, X-Ray and Zyglo Machine, and leak detectors.	Inspects and tests electronic and electromechanical components, which include: tubes, transformers, motor generators, and synchro resolvers.	Inspects and tests semiconductors using semiautomatic test equipment. Components tested include: transistors, diodes, resistors, capacitors, rectifiers, chokes, reactors, and rheostats.	Inspects and tests units, ground support equipment, printed circuits, cables, and relay frames. Operates staging and central records areas for project group.

Quality Control Engineering

Quality Planning	Quality Assurance	Mechanical Standards Laboratory	Electrical Standards Laboratory
Establishes Quality requirements prior to production. Maintains Quality Control Manual. Establishes data gathering and analysis systems. Prepares sampling plans, and Quality Procedures	Establishes, and assists in maintaining the Quality program during manufacture and field-usage. Prepares Quality indicator reports and assists in securing corrective action.	Inspects and maintains tools and gages. Calibrates and maintains special electronic test equipment. Performs precision measurements.	Calibrates and maintains purchased electrical equipment. Maintains primary and secondary electrical standards.

Fabrication, Assembly, and Functional Test

Fabrication	Electro-Mechanical Assembly	Electronic Assembly	Functional Test
Performs process and finished parts inspection. Monitors special processes. Performs reclamation activities.	Inspects electromechanical assemblies and units. Monitors packaging and shipping. Performs reclamation activities.	Inspects electronic assemblies and units in accordance with test procedures and instructions.	Performs final tests on units and functional tests on completed systems.

Quality Control Procurement Liaison	Field Quality Control
Conducts supplier surveillance and coordinates corrective action on purchased material. Maintains reclamation center for determining disposition of discrepant purchased material. Effects improved communications with suppliers.	Coordinates Quality and Reliability responsibilities at the customer's installation. Provides assistance to the customer in verifying rejects and resolving compatibility problems. Effects improved communications with suppliers.

Table III—Functions of the Field Engineering Organization

Field Engineering Management	Field Engineer	Field Engineering Liaison
Supervises and directs activities of Field Engineers within assigned geographical areas. Represents IBM to the customer and effects liaison between the customer and IBM in management areas.	Provides instruction for the training of customer personnel on the operation and maintenance of production equipments. Provides engineering, manufacturing, and logistics liaison between the customer & IBM. Represents IBM to the customer on a day-to-day basis.	Supplies current technical information to field locations on procedures, equipment changes, and new equipment. Keeps abreast of equipment problem areas and expedites corrective action. Provides technical assistance to the field as necessary to resolve problem areas.

The Quality Control Engineer in a Defense Electronics Industry

HAROLD L. GILMORE

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Quality Control Requirements

To add further verbiage to this topic may seem a fool hardy undertaking. However perhaps some justification can be found for it by restricting the scope, hence supplying more specific information in a particular area.

The restriction will be to quality control engineering in the defense electronics industry. This restriction carries no implication that similar responsibilities and problems in this area could not be found elsewhere. The main reason is that quality control and its associated problems become more accentuated, varied, and complex in the electronic defense industry. Since this may appear provocative at first glance, it may be useful to discuss and analyze some of the factors making for the difference.

One of the main factors is the military. Whereas commercial requirements are not quite as contractual in the area of quality and reliability, the military services and DOD are extremely so. The list of military specifications pertaining to quality, reliability, and organization is quite lengthy. Included in these specifications are comprehensive requirements for reliability and quality control organization, reporting, testing, and maintenance.

In addition to the continual pressure on quality and reliability improvement exerted by the military, pressure is also exerted for technical advancements. With each subsequent order or model change of an equipment increased demands are made for additional and/or improved equipment capabilities. This means continual change in components, increased demands on the capabilities of existing components, new inspection and test techniques, and increased inspection and test accuracy.

Now, if these new requirements are to be adequately planned for and fulfilled, quality control management must staff its organizations with capable personnel. Since the requirements are technical and becoming more so with advancing technology, the demands most naturally dictate the addition of engineering talent. As the functions to be performed by a quality control engineer are reviewed in the following paragraphs, the engineering requirements will become even more apparent.

Quality Control Engineering Functions

Design review is a most logical and effective point to begin the surveillance of product quality and reliability. Since the final performance of the end product is dependent upon the original design and selection of components, a very valuable service can be provided by the quality control representative at this stage of development. In some instances managements have chosen to provide this service through a separate organization physically located in the engineering depart-

ASQC LCS Code 300;810:60;70:436

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ment and called reliability engineering. While there is some merit to this method it is felt that, should basic philosophy dictate, this activity would be placed more functionally and effectively in the quality control organization. For if the quality control organization is to be held responsible for product performance and be required to answer for its failure, then it should be given the necessary scope and authority commensurate with the responsibility.

One additional observation is that reliability in essence is nothing more than one other additional product attribute. As such it is a characteristic that must be considered during the normal test and inspection of the product. This then is further evidence in support of including the quality control representative in the design stage of product development.

The next stage where the quality control engineer could logically be employed would be in the advanced stages of drawing releases. At this point his function would be to review all drawings for completeness, design and drafting errors, inspection requirements, and improvement. By reviewing the drawings for inspection requirements the need for additional or improved gaging equipment would become obvious and the use of cost reducing inspection fixtures could be exploited.

There are three major areas during the development and production stages where quality control engineering talent is worthwhile: malfunction analysis, test procedure review, and operator and process quality performance records.

The first to be discussed is defect and malfunction analysis. While performing this function first-hand information on the types of problems encountered in the shop and field can be obtained. In addition the establishment of failure patterns and other information that could lead to a solution or improvement not available from any other source could be accomplished. There are several courses of action that the engineer can take as a result of his efforts in this area. He can conduct vendor-customer meetings to discuss the problems, initiate design changes, and initiate manufacturing technique changes.

The electronic defense business is involved to a large extent with the assembly of many electronic parts manufactured by a host of companies. This creates the need for elaborate incoming inspection and test measures to insure the quality and reliability of incoming material. This is the second area to be discussed in the manufacturing process where the services of a quality control engineer prove valuable. In this capacity the test procedures, methods, and equipment can be reviewed for adequacy and appropriate sampling plans established. To insure standard inspection and test practices the procedures, methods, and equipment should be specified which would be an appropriate function for the quality control engineer.

Inspection of complicated equipment is not easy. Inspection sequence sheets similar to assembly sequence sheets in which the inspection procedure parallels the assembly operations are quite helpful. Quality control engineering can be called upon to provide these where necessary.

The third area which will be mentioned just in passing is operator and process quality performance charts and records. Everyone is thoroughly familiar with their uses, capabilities, and limitations.

An important followup and administrative function is the maintenance of records. The number and type of records will vary greatly from one operation to another but some of the more common ones are: drawing change notices, equipment serialization records, inspection control tags, malfunction reports, field failure reports, incoming material disposition reports, and vendor performance reports. All of the information contained in these various forms when properly utilized can provide the basis for a very dynamic quality and reliability surveillance program.

Summary

To summarize then, one can see that the role of the quality control engineer can be an important and challenging one if employed in the manner presented above. It would encompass the full scope of plant activity from design to production from vendor to customer and require knowledge of both an engineering and manufacturing nature. Although the situations he may find himself in are not always too pleasant, the satisfaction realized in helping to correct or improve the final product is compensation for the difficulties and unpleasantness.

1961 Shewhart Medal Nominations

Nominations are now being received by the Shewhart Medal Committee for consideration with respect to the Shewhart Medal Award for 1961. Previous Medalists are:

L. E. Simon	—1948	W. E. Deming	—1955
H. F. Dodge	—1949	M. E. Wescott	—1956
M. A. Brumbaugh	—1950	C. C. Craig	—1957
G. D. Edwards	—1951	I. W. Burr	—1958
E. L. Grant	—1952	P. S. Olmstead	—1959
H. G. Romig	—1953	E. R. Ott	—1960
E. G. Olds	—1954		

A letter of notification is being sent to all ASQC Section Chairmen. Any member of the Sociey is privileged to make a nomination for this honor. It is important, however, that any nomination be accompanied by suitable biographical and other information supporting the nomination so that the Committee will be able to give adequate consideration to the qualifications of the nominee.

Nominations may be forwarded to the Shewhart Medal Committee through the Chairman of the local Section, or they may be sent direct with supporting information to the Chairman of the Medal Committee, Rupert Gause, Bell Telephone Laboratories, Incorporated, 463 West Street, New York 14, New York. Nominations received by the Medal Committee on or before December 31, 1961 will receive consideration. Ten (10) copies of the letter of nomination and ten (10) copies of the supporting information will be needed for distribution to the Committee.

Controlling Quality in the Production-Engineering Climate

Part I

Editorial Note

Mr. Braverman's article is presented in two parts. Part II will appear in the December 1961 issue.

J. BRAVERMAN

Frankford Arsenal, Philadelphia, Pa.

Introduction

THE CONTROL OF PRODUCT AND PROCESS QUALITY in the production-engineering climate where new and modified weapons, ammunition, and fire control instruments are manufactured in diversified quantities and types is a real challenge. This challenge is surrounded by quality problems where the solutions do not necessarily commence with a rigid search for answers as much as it begins with the flexibility of perceptions. The real task is to place the problem in the right perspective and to measure it against the industrial situation in which it originated. Thus, with independence of movement and direction, quality control can objectively approach the wide variety of daily quality problems indigeneous to the production-engineering climate and provide rational conclusions. The objective approach, however, must possess an organized method of attack. Progression to a systematic procedure for controlling quality is a requisite.

Purpose

It is the intent of this article to describe the methods and techniques employed at the U.S. Army Ordnance installation, the Frankford Arsenal, which has a capability for production of development type items in limited, initial production runs. This is where the necessary production engineering is performed during the development phase of an ordnance item preparatory to the phase where private industry undertakes quantity production using product engineering drawings and specifications.

Background

A brief description of the Frankford Arsenal's mission in light of today's industry-government teamwork can serve as the denominator for evaluating the direction and activities of quality control.

The Frankford Arsenal today is primarily a research center with responsibility to the nation for developing and engineering mass production methods for new weapons and ammunition. Its shops are recognized authorities in the United States for optical, electronic, mechanical, hydraulic, and propellant production engineering.

The optical shops produce optical ranging, sighting, and observation equipment, and afford assembly facilities for pilot and production runs of complex optical instruments. The electronic shops have facilities for developing and producing pilot lots of printed circuits, microminiaturized components, and potted parts for computing, fire control and integrated weapon systems. Complete facilities for making pilot runs of ammunition ranging from 30 caliber cartridges to 155 mm shells, and mechanical time fuzes are maintained in the ammunition and fuze shops respectively.

These, together with a variety of auxiliary shops, are capable of producing complete, integrated guidance and control portions of weapon and missile systems, small arms and major caliber ammunition, metal components, and propellants. These shops are equipped with fine multi-purpose tools, the most modern equipment, special and automatic tools to develop and test important new manufacturing techniques, and are manned by highly trained career workmen, technicians, and scientists.

The Frankford Arsenal shops are under the Manufacturing Branch which is part of the Operations Division. Other elements of the division are the Process Inspection Office, Production Engineering Branch (the Quality Control Section is part of this branch) and Program Management Branch. The Man-

ASQC LCS Code 300:70:419

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ufacturing Branch consists of approximately 1400 skilled machinists, toolmakers, gage makers, and machine operators throughout 30 shop buildings.

Discussion

Quality Control, as described in this article, is a manufacturing support activity, concerned with detection, verification, correction, and prevention. The aim is to establish and maintain optimum levels of product and process quality. To achieve this aim quality control performs the following functions:

1. Plan, direct and coordinate quality control activities throughout the entire Operations Division (includes Manufacturing, Process Inspection, Program Management, and Production Engineering).
2. Develop and verify quality control standards, plans and procedures for division-wide and supplier application.
3. Continuously analyze, evaluate and report product and process quality and cost of achieving and maintaining this quality.
4. Investigate, analyze and correct product and process quality problems. Initiate control measures to prevent recurrence and recommend corrective action.
5. Perform research and development in sampling plans, quality control and reliability techniques and methods.
6. Provide training in quality control.
7. Delineate quality assurance requirements to suppliers and evaluate incoming material quality.
8. Feedback product and process quality data for utilization in design and production.
9. Investigate and develop new methodology in inspecting and measuring.

It has been found that the following three-stage approach to controlling quality is most effective.

Stage I — Preproduction
Stage II — Initial Production
Stage III — Process Stabilizing and Regular Production

Stage I — Preproduction

Figure 1 depicts the techniques inherent in each of these stages. While these techniques have been tailor-made to meet the quality control needs of this installation, it is felt that they are general enough to be useful in other types of production-engineering activities.

Preproduction is that stage preceding manufacturing in which the procurement, methodizing and planning are performed. It is in this stage that quality control is concerned with the six factors outlined in the top row of Fig. 1 Details of these factors are explained below.

Development of Detail Inspection Plans

Detail Inspection Plans are developed to assure standardization and the proper degree of inspection during processing and assembly. Included in such plans are the characteristics to be checked, classification of such characteristics, acceptable quality levels, types of measuring equipment and special instructions to inspectors. Inspection and manufacturing personnel normally receive these plans prior to Stage II, the start of the job in the shops. Where the job is of extremely small quantity (1-25 pieces) and of short duration (less than a month), minimum effort is directed towards the development of such inspection plans. An example of the Inspection Detail Plan is presented in Fig. 2.

Quality Alerting Procedure

Inherent in any job shop is the processing of jobs (components or assemblies) that are similar to jobs that have been previously run.

JOB ASSIGNED TO OPERATIONS DIVISION
STAGE I (PRE-PRODUCTION)
DEVELOP DETAIL INSPECTION PLANS FOR PROCESS INSPECTION
INITIATE QUALITY ALERTING PROCEDURE TO STUDY PAST MORTALITY & QUALITY PROBLEMS
DEVELOP APPLICABLE SAMPLING PLANS FOR PROCESS INSPECTION
INVESTIGATE NEW & REFINED GAGING DEVICES
DELINEATE TO SUPPLIERS THE QUALITY REQUIREMENTS OF PURCHASED MATERIAL
STUDY DRAWINGS, SPECS, REQUIREMENTS FOR POTENTIAL QUALITY TROUBLE SPOTS, DESIGN DEFICIENCIES, ETC.
STAGE 2 (INITIAL PRODUCTION RUN)
PRODUCT & PROCESS QUALITY REPORTING METHOD
ATTRIBUTE CONTROL CHARTS (p & c) PER PRODUCT & SHOP
PROCESS CAPABILITY STUDIES ON LEADING DEFECTS & POTENTIAL TROUBLE SPOTS
ISSUE QUALITY CONTROL INSTRUCTIONS TO PROCESS INSPECTION
AUDIT PRODUCT & PROCESS QUALITY RESULTS & INITIATE CORRECTIVE ACTION
TRAINING & ORIENTATION IN QUALITY CONTROL TECHNIQUES
DEVELOP NEW TECHNIQUES FOR ANALYSIS OF QUALITY PROBLEMS
COORDINATE QUALITY CONTROL & PROCESS INSPECTION QUALITY EFFORT
STAGE 3 (PROCESS STABILIZING & REGULAR PRODUCTION)
COMPREHENSIVE MANAGEMENT TYPE REPORT OF PRODUCT & PROCESS QUALITY
PERFORM STATISTICAL STUDIES ON QUALITY PROBLEMS & OVERALL PROJECTS
ISSUE QUALITY CONTROL INSTRUCTIONS TO PROCESS INSPECTION
REVIEW & ADJUST INSPECTION SAMPLING PLANS WITH NEED
VARIABLE CONTROL CHARTS (X̄R) ON LEADING DEFECTS & POTENTIAL TROUBLE SPOTS
AUDIT PRODUCT & PROCESS QUALITY RESULTS & INITIATE CORRECTIVE ACTION
ANALYZE QUALITY PROBLEMS FOR FEEDBACK TO ENGINEERING & MANUFACTURING
ANALYZE COSTS OF ACHIEVING & MAINTAINING PRODUCT & PROCESS QUALITY TARGETS

Figure 1 — Quality Control Activity During the Manufacturing Cycle

NOMENCLATURE SABOT — DWG. No. D-8672957 — WORK ORDER 91065 — DATE 5-1-60
END ITEM 105 M/M M400 — REVISION A-5-2-60 — PLANNED BY RLK. — SHEET 1 OF 2 SHEETS

OPER NO.	CHARACTERISTICS TO BE INSPECTED	SHOP	TYPE INSPECTION & A.Q.L 1st PIECE	MACHINE INSP.	LOT Major	LOT Minor	100%	GAGE OR FIXTURE	NOTES
5	3.002 +.009 DIA	9571	X	SEE NOTES	.25			INDICATOR B-8658471	CONTINUOUS SAMPLING PLAN (CSP#1) Q=190 f=1/10
5	2.9100 +.0098 DIA	"	X	"	.25			INDICATOR B-865712	CSP#1 Q=190 f=1/10
5	2.888 +.002 DIA	"	X	"		.40		AMPLIFIER A-7545830 EXP PLUG RING SETTING A-8661847	CSP#1 Q=140 f=1/10
10	3.900 −.005 DIA	"		"		1.0		SNAP DIAL B-8658425	CSP#1 Q=80 f=1/10
10	3.9000 −.0114 DIA	"	X	"	.25			SNAP DIAL B-8695273	CSP#1 Q=190 f=1/10
10	.24 +.02 LENGTH	"		"		1.0		LENGTH GAGE A-8529772	CSP#1 Q=80 f=1/10
10	ROCKWELL "B" 95 MIN	"	X	"	.40			ROCKWELL TESTOR B-9523712	VARIABLE SAMPLING RANGE METHOD (MIL 414)
15	.05 DEEP RECESS	"		"		.40		FLUSH PIN C-8645129	CSP#1 Q=140 f=1/10
15	1.40 MAX	"	X	"		1.0		LENGTH GAGE A-8645125	CSP#1 Q=80 f=1/10
20	.5164 −.0190 WALL THICK.	"	X	"	.25			INDICATOR-SET CHECK F-8645137	CSP#1 Q=190 f=1/10
20	.001 CONC. @ 2.888 ID WITH OD	"	X	"	→		X	FIXTURE D-8645123	CRITICAL CHAR.
20	7.500 −.005 LENGTH	"	X	"		1.0		SNAP GAGE C-8645723	CSP#1 Q=80 f=1/10
25	SLOTS MISSING/CORRECT	"	X	"	.25			VISUAL	CSP#1 Q=190 f=1/10
30	BURRS	"	X	"		.40		VISUAL	CSP#1 Q=140 f=1/10
35	CHROME PICKLE FINISH MIL-STD-171, TYPE I	9512		"		.40		VISUAL	SINGLE SAMPLING BY ATTRIBUTES (LOT)
	SALT SPRAY	9520		"	→		→	REFER TO INSPECTION PLAN FOR SALT SPRAY TESTING	QCP-5-60

Figure 2 — Quality Control — Inspection Detail Plan

The Quality Alerting Procedure is a technique that includes the review of the past quality performance of similar jobs. As a result of this review, past repetitive quality problems or trends are highlighted for the attention of manufacturing, methods engineering, or process inspection. The "Quality Alert Report" accompanies the job through all stages of manufacture, alerting manufacturing and inspection supervisors and workers to problems previously encountered on this or similar jobs. The important value of the Quality Alerting Procedure resides in the fact that even though the time interval between like or similar jobs may be years, the past objective evidence is still excellent reference information. While our memories can play havoc with us, due to the wide variety of jobs being handled concurrently, objective evidence seldom falls short. Figure 3 is an example of the "Quality Alert Report."

Development of Sampling Plans

Statistics is the science of detecting assignable causes in physical systems from data influenced by chance causes. Whether we have data from mass production or from short runs, as long as we have some degree of repetitiveness during the production cycle, statistical sampling methods can be applied. (In 1920, the development of the theory of small samples eliminated the need for masses of data.)

As most quality control people know, the basis for the statistical quality control approach is the concept of alikeness, rather than quantity. Alikeness implies that whether you produce 25 pieces or 2500 pieces, the amount that one part differs from the preceding one is not necessarily significant. In general tailor-made sampling plans, with their risks and limitations understood, can be applied to determine the degree of alikeness. As a matter of fact, due to the wide variety and quantity of job shop work at this installation, tailor-made sampling plans are the routine rather than the exception. Variations of both attributes (single, double, multiple, and continuous) and variables sampling are employed.

The AQL (acceptable quality level), AOQL (average outgoing quality limit), and LTPD (lot tolerance percent defective) values are considered when constructing sampling plans. Our approach to the appli-

TO: Methods Engr. & Machine Shops 182 — DATE: 7/2/59 — ALERT NUMBER: QA 65-59
FROM: Quality Control Section — WORK ORDER NUMBER: — DRAWING NUMBER: C-7523307
NOMENCLATURE: HOUSING — END ITEM: MT. TELESCOPE M-92

PREVIOUS QUALITY FAILINGS: DATE	WORK ORDER NUMBER	QUANTITY: INSPECTED	QUANTITY: REJECTED	SIGNIFICANT DEFECTS: REQUIREMENT	SIGNIFICANT DEFECTS: PART INSPECTION FINDINGS
8-17-58	69273	110	15	1.750 +.005	1.750 to 1.770
				3.9215 +.0005	3.9216 to 3.9225
1/5/59	71593	200	24	1.750 +.005	1.752 to 1.764
6/10/59	85380	27	12	3.9215 +.0005	3.9216 to 3.9223
12/1/60	96570	55	7	63 rms finish	60 rms to 100 rms
2/7/61	97810	35	10	63 rms finish	60 rms to 80 rms

REMARKS: Drill Bushing replaced on 3.9215+.0005 dimension
More frequent check of surface finish (63 rms) required

Figure 3 — Quality Alert Notice

	MAJOR			MINOR		
LOT SIZE	SAMPLE SIZE	ACC.	REJ.	SAMPLE SIZE	ACC.	REJ.
1-25	100%			100%		
26-45	25	0	1	15	0	1
46-60	30	0	1	15	0	1
61-75	30	0	1	15	0	1
76-110	30	0	1	15	0	1
111-200	40	0	1	15	0	1

(USED FOR IN-PROCESS INSPECTION)

NOTES:

1. MAJOR CHARACTERISTIC

   A MAJOR CHARACTERISTIC IS A CHARACTERISTIC WHICH IS A REQUIREMENT ON THE FINISHED PRODUCT, A CHARACTERISTIC WHICH COULD PREVENT THE COMPONENT OR ASSEMBLY FROM MEETING THE FINISHED PRODUCT REQUIREMENT AFTER PROCESSING OR A CHARACTERISTIC WHICH COULD AFFECT THE ASSEMBLY OF THE END PRODUCT, OR CAUSE FAILURE TO FUNCTION IN ACCORDANCE WITH THE INTENT OF THE DESIGN.

2. MINOR CHARACTERISTIC

   A MINOR CHARACTERISTIC IS A CHARACTERISTIC WHICH WHEN DEFECTIVE, DOES NOT MATERIALLY REDUCE THE USABILITY OF THE UNIT OF PRODUCT FOR ITS INTENDED PURPOSE SUCH CHARACTERISTICS ARE RADII, CHAMFERS, CLEARANCES, FRACTIONAL TOLERANCES OR EQUIVALENT, WORKMANSHIP, PIECE MARKING, AND ROUGHING OPERATIONS.

Figure 4 — Single Tables for Small Lots (one to 200 pcs.) and AQL's Less Than 0.65 Percent

cation of a sampling plan is that (1) it should guarantee customer requirements, (2) it should be easy to understand and apply, (3) it should be statistically sound, and (4) it should be surveyed during operation. An example of a specialized attribute sampling plan for small lot sizes is illustrated in Fig. 4. An example of classified characteristics and their associated AQL's is shown in Fig. 5.

Investigation of New and Refined Gaging and Measuring Devices

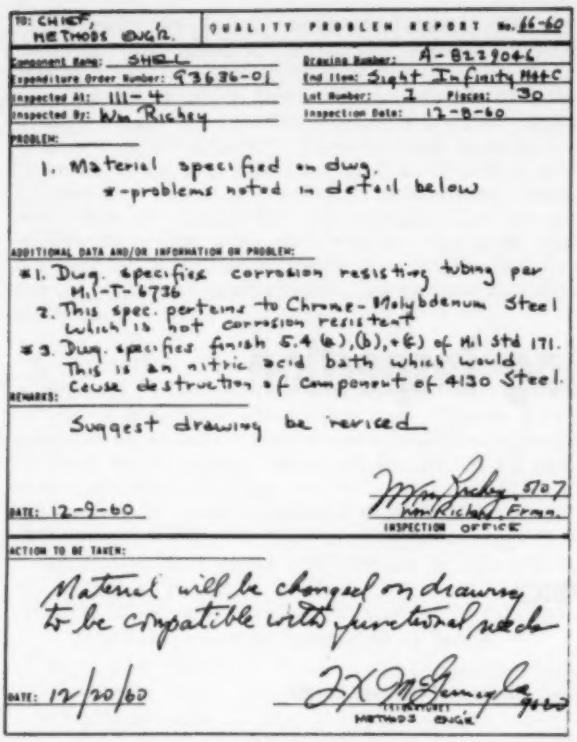
The production-engineering of items of varying complexities makes necessary a flexible measuring program. Coupled with this, from the quality control viewpoint, is the search for adaptations of gaging and measuring equipment to semi-automated and fully automated systems for highly efficient process control. Quality Control is not concerned with specifying and ordering production gages and measuring equipment — this is the job of process inspection. Quality Control is, however, concerned with advancing the application of new or refined gages and measuring equipment in order to realize — as soon as possible — increased inspection productivity, repeatibility of readings, greater accuracy on tolerances of the magnitude of 0.00005 inches, — the means by which operators can control and guide their process before spoilage occurs. For example, an investigation might be undertaken to adapt pneumatic or electronic gaging equipment to computers so that the capability of processes can be rapidly determined. An extension of this idea in variable control charting feeds the subgroup individual measurements directly into computers together with control limits. The rapid answer indicates whether to continue to run, adjust, or stop the process. Another type of investigation might be

LENSES	RETICLES	PRISMS, MIRRORS, WEDGES	WINDOWS, FILTERS	OPTICAL SUB-ASSEMBLIES
MAJOR	*MAJOR*	*MAJOR*	*MAJOR*	*MAJOR*
1 Diameter	1 Diameter	1 Light Dev., Pyr. Error and Perpendicular to base.	1 Diameter	1 Completness of Assy.
2 Axial Thickness	2 Accuracy of Pattern	2 Sph. Power, Light Path, Resol. and Astig.	2 Resol., Sph. Power, and Astig.	2 Presence of Sealing Comp.
3 Optical Requirement	3 Displacement of Pattern	3 Reflect. and Light Trans.	3 Light Deviation	3 Dim. Governing Fit with Mating Part
Equiv. Focal Length	4 Surface Qual. Inner Zone (Up to 20-10)	4 Cement and/or Strength of Bond.	4 Reflect. and Light Trans.	4 Optical Requirements
Back Focal Length	5 Thickness of Etched Lines	5 All Linear Dim. with Tol. range up to .010" and Angular Tol. range up to 10 min.		
Concentricity				
Definition				
4 Cement				
5 Surface Quality (Up to 20-10)				
MINOR	*MINOR*	*MINOR*	*MINOR*	*MINOR*
41 Surface Quality (above 20-10)	41 Deviation	41 Volume	41 Thickness	41 Presence of Part No.
42 Coating	42 Surface Qual. Outer Zone (above 20-10)	42 Surface Quality	42 Surface Quality	42 Finish
43 Coating Hardness	43 Chamfer	43 Coating and/or Alum. Qual.	43 Coating Quality	43 Condition of Optics
44 Edge Thickness	44 Thickness	44 Coat. Hardness and/or Alum. Adherence.	44 Coating Hardness	44 Cleanliness
45 Chamfer	45 Presence of Part No.	45 Protective Backing	45 Limit Edge Defects	45 Coating
46 Limit Edge Defects	46 Rim Ground or Polished	46 Presence of Blackening	46 Chamfer	47 Workmanship
47 Presence of Part No.	47 All Other Etch Data	47 Presence of Part No.	47 Rim Ground, Polished or Blackened	
48 Blackening of Rim	48 Workmanship	48 All Linear Dim. with Tol. Range above .010" & Ang. Tol. range above 10 min.	48 Presence of Part No.	
49 Workmanship		49 Workmanship	49 Workmanship	

TYPE OF ELEMENT	GRIND		POLISH		CENTER		COAT		CEMENT		ETCH		ASSEMBLY	
	MAJOR	MINOR	MAJOR	MINOR	MAJOR	MINOR	MAJOR	MINOR	MAJOR	MINOR	MAJOR	MINOR	MAJOR	MINOR
Lenses	6.5%	6.5%	2.5%	4.0%	1.5%	4.0%	1.0%	2.5%	0.65%	2.5%				
Reticles	1.5%	4.0%	1.0%	4.0%							0.65%	2.5%		
Prisms Mirrors, Wedges	1.0%	4.0 (2.5)[a]	1.0%	4.0%			1.0 (0.65)[b]	2.5%	0.65%	2.5%				
Windows, Filters	1.0%	4.0(2.5)[a]	1.0%	2.5%			0.65%	2.5%						
Optical Sub-assemblies													0.65%	2.5%

AQL in parentheses to be used: a. for "Save Surface Quality" Material,
b If Step indicated is last processing area.

Figure 5 — Classification of Defects and AQL's to be Used in Process Inspection for Various Types of Optical Elements and Sub-Assemblies



TO: CHIEF, METHODS ENGR. | QUALITY PROBLEM REPORT No. 46-60

Component Name: SHELL — Drawing Number: A-8229046
Expenditure Order Number: 93636-01 — End Item: Sight Infinity M48C
Inspected At: III-4 — Lot Number: 1 — Pieces: 30
Inspected By: Wm Richey — Inspection Date: 12-8-60

PROBLEM:

1. Material specified on dwg.
*-problems noted in detail below

ADDITIONAL DATA AND/OR INFORMATION ON PROBLEM:

*1. Dwg. specifies corrosion resisting tubing per MIL-T-6736
2. This spec. pertains to Chrome-Molybdenum Steel which is not corrosion resistant
*3. Dwg. specifies finish 5.4 (a),(b),+6) of Mil Std 171. This is an nitric acid bath which would cause destruction of component of 4130 Steel.

REMARKS:

Suggest drawing be revised

DATE: 12-9-60 — Wm Richey 9107 Wm Richey Frmn. — INSPECTION OFFICE

ACTION TO BE TAKEN:

Material will be changed on drawing to be compatible with functional needs

DATE: 12/20/60 — J K McGinley 9600 — METHODS ENGR.

Figure 6 — Quality Problem Report

the attempt to automatically perform visual inspection on brass ammunition cases on a continuous basis. An electro-mechanical device with an automatic loading and feeding device might be considered for evaluating surface nicks, dents, etc., with the findings fed into a computer which automatically calculates the total fraction defective and also the fraction defective for Major and for Minor defects.

Then again, consideration might be given to a gaging device which will standardize optical inspection, to eliminate the wide influence of human judgment. The light source, positioning of the elements, viewing, and comparison with standards would be made uniform for all elements within the job and between jobs.

There is a very positive need in quality control, early in the life of the product, to consider newer and better ways of gaging and measuring.

Quality Requirements for Suppliers

Difficulties encountered by suppliers in producing satisfactory Ordnance quality can be related many times to inadequacies in the supplier's quality control, as well as to lack of understanding between the supplier and Ordnance as to what constitutes satisfactory product quality. These problems emphasize the importance for Ordnance to develop more meaningful specifications, to provide suppliers with realistic quality assurance provisions, to maintain real cooperative relations with suppliers, and to evaluate the supplier's product and process quality more accurately and objectively.

Thus, in helping the supplier to meet the Frankford Arsenal product quality requirements, we are now detailing to our suppliers, at the time the bids are asked for, the quality assurance specifications. General requirements include such features as Supplier (Contractor) Inspection System, Verification of Supplier (Contractor) Inspection System, Tolerances, Workmanship, Finishes, etc., while detailed requirements cover the AQL's (acceptable quality levels), CC's (classification of characteristics), and sampling plans. We feel that good communications between Frankford Arsenal and its suppliers (contractors) is the key to (1) good vendor relations, (2) getting out of trouble as soon as possible but mostly (3) avoiding trouble in the first place. With effective communication of product quality requirements, suppliers will (1) know what is expected of them, (2) obtain a good idea of quality control techniques desired by the Frankford Arsenal, (3) be assured of consistent practices between supplier inspection and Frankford Arsenal inspection surveillance, and (4) provide sound, objective evidence for Frankford Arsenal evaluation in product acceptance.

Review of Drawings and Specifications to Determine Potential Trouble Spots Before Job Starts

Detection and prevention are to quality control as acceptance is to inspection. Prevention is certainly more economical and dramatic than a pound of after-the-fact cure. Thus, quality control reviews the drawings and specifications of new jobs for the purpose of detecting potential quality problems, design deficiencies, or methods engineering conditions which might be adverse to high product yield. The recognition of such problems or deficiencies are brought to the attention of the proper personnel in writing (Fig. 6). The bottom portion of Fig. 6, provides space to describe the type of corrective action to be taken, and quality control follows through to determine if such action was taken and if it was truly corrective.

(Editorial Note—Part II of Mr. Braverman's article will appear in the December 1961 issue.)

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WHY NOT SEND YOURS IN TODAY?

A B C's of Receiving Sampling Inspection

SIDNEY PRICE

International Business Machines Corp., Command Control Center

Federal Systems Division, Kingston, N. Y.

IN A RECEIVING INSPECTION operation, there are many inspection paths available to the inspection manager. He can decide to do a 100 percent inspection on every item received, he can sample the lot, or he can decide to do a combination of sampling and 100 percent inspection. In making the decision between 100 percent inspection and sampling inspection, many factors have to be considered. Since the title of this article is "ABC's of Receiving Sampling Inspection," it is apparent that this discussion will concern itself with sampling. But why not do 100 percent inspection?

The reader may have heard that 100 percent inspection is time consuming, that it is costly and that it is only 85 percent efficient. Let us evaluate these criticisms. As an example of 100 percent inspection, assume that the following paragraph is a LOT of material received. It could be screws, nuts, bolts, or any item ordinarily processed through receiving inspection. Let's do a 100 percent inspection to look for defects. Before starting you have to know what to look for; so call the letter "f" a defect. Every time you see an "f" count it as one defect. Read the paragraph *once and only once*, counting the "f's."

"This plant employs several thousand people. It is run by a manufacturing superintendent and an engineering head. Each is independent but responsible to the home office for portions of the plant's operations. Together they comprise top management of the factory, with the marketing and sales function being carried on through the home office. Although theoretically complex, this plan of organization had worked satisfactorily for many years."

Now that you've read the paragraph you have performed a 100 percent inspection of the lot. If you read it twice, you did 200 percent inspection. If you read it three times, you did 300 percent inspection. How many defects did you find, 6, 9, 11, 13, 14? There are actually 13. If you want to be certain of finding them all, continue reading the paragraph until you do. Don't forget, however, that every time you read the paragraph, you perform another 100 percent inspection. The "f" is a very obvious defect. There is no question as to whether it is black, white, undersize or oversize. Even though this defect is very clearly defined most people find only eight on their first try.

Now let's take another approach. Assume that instead of doing a 100 percent inspection we decide to sample the lot. If you were to count all of the pieces in the lot (in this case, all of the letters) you would find that there are 364. This then is our lot size. We have determined that there are 13 "f's," or defective pieces, in the lot. Thirteen out of 364 is about 3.5 percent, so we can say that our lot contains 3.5 percent defective pieces.

Here's where AQL's (Acceptable Quality Levels) come into play. First we have to establish our AQL. In other words, how many defective pieces can we accept and still keep our manufacturing operation going. You're probably thinking, "I don't want any defective pieces. What can I do to assure that I will not have any?" This can be accomplished by either

ASQC LCS Code 221:70:400

*Presented at Eastern Regional Meeting of Metal Etching and Fabricating Association, Nov. 3, 1960

doing many screening operations (several 100 percent) in inspection or by setting extremely tight specification limits to minimize the number of defects produced. Since there will always be some defective pieces the question still stands "How many defects can we accept?". Therefore an analysis has to be made for every part received as to how it is to be used and how it will affect manufacturing operations. Let us assume for this example that we are willing to accept a lot if it contains no more than 4.0 percent defective material. You will recall that our lot contained approximately 3.5 percent defective material.

ASSUMING that we are willing to accept 4.0 percent defective material we refer to a sample table and determine the sample size. (Figure 1 is a sampling table developed for use by IBM, Kingston.) Looking at the sample table we see under 4.0 percent AQL, for a lot size that falls between 301 and 500 pieces, we have to select a sample of 25 pieces. The sample table also tells us that:

1. If you find either (0) defects or (1) defect accept the lot.
2. If you find more than (1) defect but less than (5) take a second sample of 45 pieces.
3. If you find five or more defects in the first sample reject the lot.
4. If you have to take a second sample, of the total of seventy pieces that you looked at (25 in the first sample and 45 in the second), reject the lot if you find a total of six or more defects.

Now let's look at our lot. If we were to count off the first 25 letters and call this our sample, we wouldn't find any defects so the lot would have been accepted. If the second 25 pieces were our sample, again we would not find any defects and the lot would have been accepted. Following this procedure of taking groups of 25 pieces, we would find that we would have either accepted the lots on the first samples, or would have had to take second samples. But in any event, we would still have accepted all of the lots. If the sample were randomly picked from the whole lot, however, we could conceivably find enough defects in the sample to reject the lot. But with lots such as ours that are no more than 3.5 percent defective, using a 4.0 percent AQL, the probabilities are that the lots would be accepted at least 95 percent of the time and rejected only five percent of the time. Then, depending upon how badly the rejected lots are needed, they can be screened to remove the defects. Following this procedure we would do 100 percent inspection only about five percent of the time.

Now, using the same lot and knowing that it contains about 3.5 percent defective material, let's reduce the number of defects that we are willing to accept because defective pieces have proved too costly. We must tighten our inspection and establish our AQL at one percent. Referring again to the sample table we find that our first sample is 35 pieces; we are not allowed any defects in the first sample; if we find less than three defects we have to take a second sample of 50 pieces; and we will reject the lot if at any time we find a total of three or more defects.

IBM.

NORMAL SAMPLING PLAN

INTERNATIONAL BUSINESS MACHINES CORPORATION
KINGSTON, N. Y.

ISSUED BY QUALITY ANALYSIS DEPT. 5-55

LOT SIZE	AQL .65					1.0					1.5					2.5					4.0				
	N_1	C_1	R_1	N_2	R_2	N_1	C_1	R_1	N_2	R_2	N_1	C_1	R_1	N_2	R_2	N_1	C_1	R_1	N_2	R_2	N_1	C_1	R_1	N_2	R_2
0—40	20	0	1	—	—	15	0	1	—	—	10	0	1	—	—	7	0	1	—	—	5	0	1	—	—
41—100	25	0	1	—	—	20	0	1	—	—	15	0	1	—	—	15	0	3	25	3	10	0	3	25	3
101—200	30	0	1	—	—	25	0	1	—	—	20	0	3	35	3	15	0	3	25	3	15	0	4	25	4
201—300	35	0	1	—	—	30	0	3	50	3	25	0	3	35	3	20	0	3	35	4	15	0	4	30	4
301—500	55	0	3	60	3	35	0	3	50	3	25	0	3	35	3	30	1	4	50	5	25	1	5	45	6
501—800	60	0	3	65	3	40	0	3	70	4	30	0	3	55	4	35	1	4	65	6	30	1	5	65	8
801—1300	65	0	3	110	4	70	1	4	105	6	60	1	4	90	6	45	1	5	95	8	45	2	6	80	9
1301—3200	80	0	3	175	5	95	1	5	175	8	90	2	6	170	10	65	2	6	145	11	50	2	7	105	12
3201—8000	145	1	4	300	8	160	2	6	300	12	120	3	7	210	12	95	3	7	180	13	70	3	8	120	13
8001—22,000	175	1	5	415	10	170	2	6	390	14	170	4	8	320	16	125	4	8	250	18	100	5	10	180	16
22,001—100,000	250	2	6	490	12	225	3	7	490	16	210	5	9	400	19	170	5	10	310	22	130	6	11	210	19

SAMPLING PROCEDURE

1. Select the first sample, N_1, as indicated by the lot size and AQL class. Inspect the sample for all characteristics in the AQL class.
2. Determine the number of defective pieces in this sample.
   (a) If the number of defective pieces is equal to or less than the figure shown in Column C_1, accept the lot.
   (b) If the number of defective pieces is equal to or greater than the figure shown in Column R_1, reject the lot.
   (c) If the number of defective pieces is greater than C_1, but less than R_1, select a second sample as indicated in Column N_2. Inspect the entire second sample for all characteristics in the AQL class.
3. Determine the number of defective pieces found in the second sample. Add to this the number of defective pieces found in the first sample.
   (a) If the total number of defective pieces is less than the figure shown in Column R_2, accept the lot.
   (b) If the total number of defective pieces is equal to or greater than the figure shown in Column R_2, reject the lot.

Figure 1

Going through the lot again we find that we will accept the lot based on our first sample some of the time; we will have to take a second sample occasionally; but more frequently we will have to reject lots on either the first or the second sample. This second example of sampling shows that lots containing more defects than we're willing to accept will have to be screened much more frequently than those containing an acceptable number of defects.

You are probably asking, "Why is it that every time a lot is rejected based on sampling you have to go back to 100 percent inspection, remembering that 100 percent inspection is only 85 percent accurate?" Let's review what we did. First, we decided that we would accept a percentage of parts that contained defects, as in the two examples used. By sampling the lot we were able to estimate the percentage of defective parts it contained. If this percentage were lower than the standard we had established, we accepted the lot; but if the percentage of defects were higher we rejected the lot.

Now the decision has to be made as to whether to return the rejected lots to the vendor because he was sending us more defective material than we were willing to accept or whether we should screen the lot ourselves. Don't forget, 100 percent inspection is only about 85 percent accurate. In other words, we can only expect to find about 85 percent of the defective parts in the lot by doing a 100 percent inspection. We can assume that in the sample we inspected for the letter "f" for example, we would probably miss two or three. Since this is the case, we would take another sample of the lot after we had done the 100 percent inspection to determine whether or not the percentage of defective parts is now within the AQL we had set up. If, after doing the 100 percent screening and then inspecting to the AQL again, the lot meets our requirements, we would accept it. This points up one of the biggest advantages of sampling over 100 percent inspection, namely that when we're finished with sample inspection we have some idea of how many defective pieces are in the lot, but, with 100 percent inspection we're not sure.

IN ACTUAL PRACTICE, describing a defect is not as simple as saying that an "f" is a defect. In fact, it is customary to evaluate the defects we're looking for and call some minor, some major and some critical. We can then assign loose AQL's to the minor types of characteristics and tighter AQL's to those more important. We can also go a step further and assign a constant sample size to those items which are made on automatic equipment such as punch presses, since these items ordinarily have little variation from one piece to another. At IBM in Kingston we usually inspect ten pieces for characteristics of this type. Where items are made in molds however, we would assign a sample size to each mold cavity. In the event that we find a defect in a constant sample we go to a tighter AQL and then screen if necessary.

In assigning AQL's one has to study the source of the item, the ease by which the manufacturing process is controlled, the end use of the product in the particular application and the probabilities that the part could be defective. Relatively simple and inexpensive items can be the cause of scrapping expensive assemblies when they cannot be removed from the assembly.

In most cases a three-piece sample will suffice for minor characteristics, a ten-piece sample for characteristics controlled by automatic processes, a 1.0 percent AQL for major characteristics and a 0.65 percent or tighter AQL for critical characteristics. At the IBM Command Control Center, Federal Systems Division in Kingston, N. Y., the function of the item is normally considered a major characteristic and assigned a tight AQL. For example, the electrical qualities of a capacitor (capacitance), a resistor (resistance) or an inductor (inductance) are assigned major AQL's, whereas lead length or lead straightness can be assigned minor AQL's. There are exceptions to these general classifications, of course, based on the knowledge of where and how the part is used. As an example, on resistors for hand assembly, lead length, lead straightness, lead concentricity are considered minor characteristics. However for automatic assembly purposes these characteristics become critical. Many times, the buyer and the seller must agree upon the desirability of 100 percent or sample inspection. They must also determine the AQL.

The customer's cost for the item can also be influenced by the decision as to who will accept responsibility for the rejected parts. In the final analysis, deciding whether to sample or to do 100 percent inspection takes careful consideration on the part of the receiving inspection manager.

The selection of a sample table is a matter of choice. There are many sampling plans available. Mil-Std-105 is an excellent set of tables. It can be purchased from the United States Government Printing Office, Washington, D. C., for 30 cents. Most quality control texts or handbooks contain sampling plans which can be used by the quality control man without elaborate statistical background.

Total Quality Control

"We must not misread the signal that is flashing today. It is saying that we must gear up our industrial programs to meet a much higher quality standard market than any of us have seen in this generation." This statement comes from Dr. A. V. Feigenbaum, ASQC President.

To meet the demands of a new era in business—an era in which business strategies will emphasize a quality level that is far more than just "good enough"—a new technology is called for. Dr. Feigenbaum calls it "quality engineering." To be effective for today's market place, a company's quality control program must begin with product research, development and design and carry through to the point when the product is in the hands of the customer and backed by proper service facilities.

The concept of total quality control was introduced by Dr. Feigenbaum in the *Harvard Business Review* in 1956. Dr. Feigenbaum has now written a full treatment of the subject in *Total Quality Control: Engineering and Management.*

Dr. Feigenbaum's book gives "total" coverage to "total" quality control. Additional information and an order form appear on page 32 of this issue.

The Great War for Reliability

LEE B. GRAY

North American Aviation, Inc., General Offices, Los Angeles, Calif.

Introduction

Everyone today is an "expert" when it comes to organizing his company to meet the requirements of a reliability program. Anytime a multitude of experts exist on one subject, a conflict results. As a result of the conflict regarding which organization controls the magic word "reliability," there has developed a continuous "war" between the quality control expert and the reliability engineering expert. It is not intended that this article solve the total reliability organization problem, but it is hoped that it may stimulate interest in better understanding the problems faced by each of the participants. It is indeed difficult to solve a problem without defining it. Let's take a crack at definition of the problem.

Conference No. 1

The conference room was heavy with smoke. The table was cluttered with documents. In this atmosphere it was apparent that important business was being conducted. If you glanced at the written information appearing on these documents, you would find that the magic word "reliability" appeared several times in each paragraph. Tacked on the wall behind the chairman's position was a banner which revealed that this important meeting was being held by members of a well-known professional group for quality control.

The meeting chairman cleared his throat and the conferees leaned forward attentively. With great eloquence, the following words flowed fluently from the chairman's tongue. It was evident that the words which he spoke came from his heart. "Gentlemen, reliability is clearly a characteristic of quality." The members quickly nodded in silent agreement.

The chairman spoke again: "As loyal members of this society, it is paramount that these words should not be forgotten. Let us now stand and face our banner and repeat aloud three times 'Reliability is a characteristic of quality'." The members arose and chanted the phrase solemnly. Once reseated, the chairman addressed the group: "Now Gentlemen, let us proceed with the work at hand. This committee has been formed to attempt to define the word 'Reliability.' Inasmuch as it is definitely a characteristic of quality, we should expend all effort to discover what it means. Whatever it is, it is ours, and we must work unceasingly to improve it."

ASQC LCS Code 810:60;70:400

Conference No. 2

In a city 2000 miles removed from the place of the aforementioned conference, another meeting was in session. Crowded around the conference table were a group of distinguished gentlemen sipping coffee and awaiting the start of the conference. On the wall hung a banner of a notable engineering society. Even without this banner, the group would be readily indentifiable by the six-inch slide rules carefully clipped into each breast coat pocket. Scattered around the table were various documents containing material in narrative form, mathematical equations and assorted curves. The word 'reliability' was sprinkled copiously throughout these papers and charts.

The chairman strode briskly into the room and the meeting began. He ground out his cigarette in an ashtray and said, "Gentlemen, reliability is merely another design parameter. It is therefore quite obvious that reliability effort should be concentrated in our engineering departments and engineering should be the responsible reliability authority within our member companies."

The chairman paused and then said, "Let us repeat our pledge." The members arose and chanted in unison, "Reliability is a design parameter. I shall dedicate full effort toward keeping reliability within the bounds of my department and shall fight with all my heart and soul to keep out such parasites as manufacturing, quality control, and field service."

The conferees resumed their seats and the chairman commenced the discussion for the session. "In that 'reliability' is of such great importance and inasmuch as we are guardians of this design parameter, it would be an excellent undertaking for our group to derive a definition for this term. I propose that we select a task group . . . , etc."

The War for Control

We have just been privileged to eavesdrop into two separate meetings being conducted by two professional groups and it is readily apparent that the topic for discussion was somewhat similar. As the saying goes, "The music was the same, but the lyrics differed." Each group was convinced that reliability was its business yet neither one had gotten around to really defining the term. These cases were exaggerated and purely hypothetical, but I am sure that they remind us all of meetings that we have participated in. How many times have you heard the phrase "Reliability is everybody's business?" You know that the man who says this usually is silently muttering under his breath, "Reliability is everybody's business, all right, but it just so happens that my group is responsible for 95 percent of it."

Why is it that reliability has become such a popular word that organizations are engaged in a minor war to capture it for their exclusive use? It was not too far in the past that people gave you a weird look when you mentioned the word. You could almost read their minds as they eyed you with that knowing look, "Here's another of those 0.999 boys. I'm probably in for fifteen wasted minutes of statistical mumbo-jumbo." Today, when you speak of reliability, ears perk up all around you. You soon find that the teams have been chosen and they wonder which side you are on.

Everyone, today, is aware that reliability is something to be reckoned with. Not everyone fully understands the term, but everyone is very willing to express deep-felt opinions on the subject. It appears that industry interest in reliability has increased in direct proportion to the customers' complaints concerning the unreliability of modern systems.

A review of the organization charts of various companies in the defense industry reveals that there are about as many ways to organize a reliability program as there are companies. There appears to be no set pattern which works for all companies. The question then actually arises, "Is there a standard way to organize a company that will best meet present reliability requirements?"

Reliability Organization in the Military

To answer this question, let us turn to the military for assistance. As our largest customer and the biggest booster for reliability, they can certainly provide some clues as to how we should solve the reliability organization problem. In that the word "military" is indeed a broad term, let us narrow it down to one branch of the Armed Services. Let's take the Air Force as our example. The Air Force is by far the heavyweight in the field of reliability with several years of experience in this area.

In Engineering?

The Air Force recently came out with a new regulation concerning reliability. It is AFR 375-5, dated Oct. 17, 1960, bearing the title "Reliability Program for Weapon, Support, and Command and Control Systems." Certainly, the document which governs our customer will be very specific as to who or what organization is responsible for reliability. Ah yes, here on page 2, paragraph 3.h. At last we have the answer. It states that reliability belongs to management and engineering. Well, I guess that ought to put the squelch on those inspectors! Here it is in black and white. Reliability belongs to us engineers and the boss. So from now on if you want the answers on reliability, come to us.

A Separate Organization?

However, we should explore further to insure that we have all the facts. It appears that the engineers do not have the reliability field sewed up. Here is another document that appears quite official. It is an Air Force Ballistic Missile Exhibit Number 58-10 and it has to do with ballistic missile reliability programs. AFBM Exhibit 58-10 is a part of the contract and this is really what counts. This document is very specific concerning the control of reliability. It states that reliability must be the responsibility of a separate organization. You engineers step aside. Here is the opportunity to build an entirely new empire!

In Quality Control?

You still have further to go before the problem is solved. We have another document. MIL-Q-9858 is our top Quality Control specification and it and its associated documents hold us responsible for assuring that we are producing a top quality item. One of the attributes of quality, in our definition, is reliability. If we are going to vouch for the reliability of our products, then we must take a very active part in its attainment. We must insure that contract requirements are met. If reliability is in the contract, then we can't be counted out.

Moves Toward Peace

The Problem

The preceding paragraphs are obviously somewhat of a satire. When you sit back and think it over we sound rather foolish. We should take a seventh inning stretch and get serious about the responsibilities involved in management of a reliability program.

It is first important to realize that reliability is not easily defined. It is neither just a characteristic of quality nor merely another design parameter. It would be a lot easier if we could worry only about the quantitative side of the problem and concern ourselves simply with the mathematics of probability. Is the old and tired statement that "Reliability is everybody's business" completely worthless? Certainly it is not. Any one of the partners in the reliability business can have a direct effect on the achieved reliability of the product. If manufacturing or quality control drop the ball, reliability will suffer no matter how good the original design.

Do we need a separate organization for reliability? Do we need a standard reliability organization for all programs? The answer to both questions is a definite NO! There are cases where a separate reliability organization can do more harm than good. An outside organization starts out with two strikes against it. It has to fight to win acceptance in the long-standing organizations. This is a fight which often never ends. In the same manner that reliability must be inherent in the design, it must also be inherent in the organization.

Most companies have achieved a strong organization which best fits their needs. This organization provides a firm base upon which a reliability program may be constructed.

An Approach Toward Solution

Where does this then leave us? We are back to the war for control over reliability. The way out appears to be a scheduled and properly planned reliability effort. This can be accomplished only when responsibilities are well-defined and reliability is integrated into an organization that is basically strong.

Engineering

The Engineering department is the first to come in contact with reliability and it should never completely lose contact throughout the entire program. The reliability analysis activity should remain in the engineering area during the entire program. Many will argue this point and say that the analysis effort should shift to quality control during the production phase. I disagree, for it is in engineering that the future design changes will eminate. It is in engineering that the data generated on the present program will be used as a prediction tool for future programs. Reliability analysis is a basic engineering tool and should remain under its authority. Engineering changes occur until a program is finally terminated. Each of these changes should be analyzed as to its effect on reliability.

Quality Control

Where, then, does quality control fit into the picture? Quality control enters the reliability picture early in the initial design phase. It must have a basic understanding of the design so that proper control procedures can be

derived to insure minimum reliability degradation during manufacture.

During manufacture, it is the job of quality and reliability assurance (quality control) activities to insure that reliability requirements are met. The control of process is a prime responsibility. Variations in process must be identified and eliminated or reliability cannot accurately be measured. If each item produced varies excessively from each other item, then we cannot hope to control our product's reliability. Quality control is the prime source of reliability data during production. It should analyze these data from a quality standpoint, but not attempt a detailed engineering analysis. Production data should be transmitted in a useful form to engineering for its use in the design effort.

In saying this, I do not intend to degrade the engineering capabilities of a good quality assurance or analysis group. It takes high caliber engineering talent within quality control to understand the engineering requirements and do an adequate job of production reliability assurance.

The above qualifications of personnel also applies to the logistics or field service areas of the reliability program where the operational reliability information will be generated. However, this article does not bring logistics into the war for reliability even though it too suffers many battle scars.

Who is Responsible?

So the question still exists, "Who is the *one* responsible for reliability?" The military has a good system for nailing down responsibility; it is always the Commander. In the case of reliability, it is no different. The boss is responsible. The company president has final responsibility. He may choose to delegate certain responsibilities to a "reliability manager" who is responsible for overall reliability program coordination. Even then, this "reliability manager" does not "own" the reliability program. It belongs to the engineer and the quality control man alike.

This brings us back to the "war." Why do the engineers and quality control experts argue? Well, for one thing, they have always argued! We have still turned out high quality products and they are probably better because somebody bothers to argue. Reliability engineering and quality control provide an excellent system of checks and balances. However, these two groups should combine forces in a united effort at various phases of the program. Design review is an excellent example where the joining of forces between the reliability engineer and the quality engineer will result in a more reliable product. Each looks at the design from a different aspect, yet they both have a common goal — a highly reliable and top quality product.

A reliability program does not have to be uniquely administered; however, like any other program, it requires clear cut lines of responsibility. The determination of these lines of responsibility must come from top management. As has often been expressed "Reliability is a management discipline."

Once the lines of responsibility have been clarified, the "war" will not stop. There will still be arguments, but they will be constructive arguments toward raising our product reliability.

From the Scrap Box

IRVING W. BURR, *Editor*
Purdue University, Lafayette, Indiana

On the Fairfield Nomograph

In the November, 1959 issue of Industrial Quality Control

To the Editor:

Users of the excellent nomograph accompanying the note "A Rapid Method of Comparing Two Percentages" by J. H. Fairfield (Volume XVI, No. 5, November, 1959, page 20, *IQC*) should be wary of two considerations. First, the average percentage should be calculated as shown in the example and not taken as the simple mean of p_1 and p_2. The formula for the appropriate weighted average is $p = (n_1p_1 + n_2p_2)/(n_1 + n_2)$ and it is simply obtained (as the author shows) by dividing the total number of defectives by the total pieces inspected.

Second, the accuracy of the result (especially for small numbers of defectives) can be improved considerably by making an adjustment for the fact that a continuous curve (normal distribution) is being used to approximate a discrete system (binomial distribution). The adjustment is well known as "Yates' correction" and, although usually included in the initial calculation, can still be used with this nomograph as follows:

1. Use the nomograph in the manner outlined to calculate a value of t.
2. Repeat the procedure after increasing the smaller number of defectives by one and decreasing the larger number of defectives by one.

   That is to say, find the next lower possible value of t that could have arisen with the same sample sizes and the same total number of defectives.
3. Take the mean of these two values of t. The probability corresponding to this average t is the significance level reached by the original data. It should be noted that this adjustment always decreases the significance and hence is required only for results which are (questionably) significant.

Two other informative articles which have appeared in *Industrial Quality Control* might prove of interest to readers of the present article. They are Duncan, A. J., "Chi Square Tests of Independence and the Comparison of Percentages," June, 1955; and Satterthwaite, F. E., "Comparison of Two Fractions Defective," November, 1956.

Lloyd S. Nelson
General Electric Lamp Division
Cleveland, Ohio

ASQC LCS Code 510;422;423:60;70:000

What's New?

ROY A. WYLIE, *Editor*

1101—A new, *portable strain indicator* — providing digital readout and twice the gage factor range previously provided — has been announced. Designated the *Type 20*, the new indicator represents a significant improvement and provides these new features:

Digital readout—eliminating interpolation from dials and meters; *Double gage factor range* — increased from the former range of 1.77 through 2.22, to a range of 1.50 through 4.50 in the new indicator.

The indicator is designed to give simple, fast, dependable operation with most commercially available strain gages in one-, two- or four-arm networks, and with strain gage transducers — bonded or unbonded — to provide direct indication of the measured variable. Strains are read directly as the sum of the digital counter indication and the "add-to-reading" setting. Accurate setting of the gage factor is accomplished through use of a duodial. The counter gives readings from zero through 5000 micro-inches per inch in ¼-inch-high white numerals on a black background. There are 12 intervals in the range from zero through 60,000 M.I. per inch. Accuracy is 0.1 percent of reading, or 5.0 M.I. per inch, whichever is greater. Readability is one M.I. per inch. The new indicator also provides a demodulated output from the scope jack so that dynamic strains — up to 50 cycles per second and 5000 M.I. per inch — can be seen, minus the carrier, on any standard cathode ray oscilloscope. Weighing 18 pounds, the Type 20 indicator is 13 inches wide, 8½ inches high and 9½ inches deep. It incorporates transistors and printed circuits, color-coded five-way binding posts and is enclosed in a rugged Formica case.

* * *

1102—A new line of *quality information and test systems* that can automatically test electrical components and circuits, classify data and compute trends has been introduced by General Electric Company to help automate industrial quality control on an economical basis. QIT systems close the control loop in the following manner: Test fixtures and sensors are provided to measure significant product parameters. An automatic program, such as on punched tape, orders the sequence of tests. Input stimuli and loads are generated and fed into the system as test reference values; these may be constant or programmed at varied limits to fit the particular product form being tested. An input-output distribution function decodes the program and ties the proper parts of the system together. A measurement function takes quantitative readings of each significant variable tested, comparing them against test reference values from the input stimuli. An evaluation and decision function interprets the measurement, normalizes the data and provides signals to automatically adjust or sort the product and automatically or manually close the control loop on the process. A data presentation and recording function provides a printout record of product performance. A feedback system provides information flow between appropriate functions and actuates mechanical devices for handling, classifying, and adjusting the product. Presently-designed quality information and test systems include an Automatic Relay Tester, three models of a transformer tester (Autotran), Multi-

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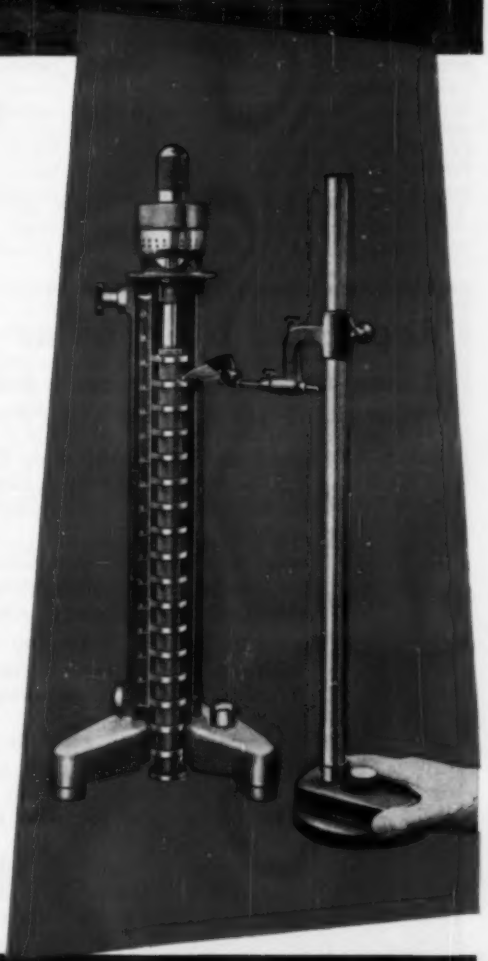

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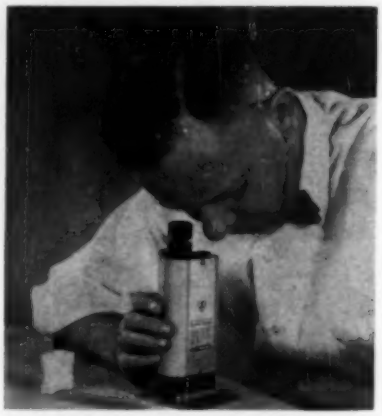
cycle reliability tester, Programmed Automatic Circuit Tester (PACT), Four-Pole Relay In-Line Tester, Automatic Transistor Classifier, Automatic Diode Grader, Basic Appraisal System for Incoming Components (BASIC), "Spark and Mark" Cable Tester, and a Dynamic Circuit Analyzer. Prices of the equipment vary from about $7800 for the Four-Pole Relay Tester to about $34,100 for the most complex Autotran system. Price for each system will vary with the particular requirements of the customer's process.

* * *

1104—Holes which cannot be measured accurately by conventional means are being gaged to extreme tolerances by actually making the part to be checked an integral unit of an *air gaging system*. By use of special low-cost fixtures, pieces can be so mounted that holes to be gaged replace air capsules, height gage heads, or other devices incorporating the nozzles otherwise necessary. For example: Carburetor jets with very fine holes are required to be gaged to very close tolerances. The holes are much too small for use of ordinary plug gages or air plugs. An instrument was designed incorporating the O ring principle, in which each carburetor jet can be precisely positioned against an opposing surface, and a stream of air sent through the hole. Measurement of air velocity easily determines if the opening is within tolerance compared to a master. Application of the principle is being constantly expanded to other areas as well as to small hole gaging. An interesting application is its use in positioning parts of cathode ray guns within the necks of TV and oscilloscope tubes. Here perforated discs must be inserted at a precise distance from the tube face plate. Using the holes in the disc as escape nozzles, the distance is accurately measured by a conventional Taft-Peirce air gage.

* * *

1103—Bausch & Lomb announces development of a *Scratch Depth Gage* which measures scratches, grooves, and other indentations on flat or curved surfaces with speed and accuracy. Because of its ease of operation and portability, the new gage provides a precise, inexpensive and non-destructive means for determining whether such surface indentations fall within prescribed limitations. It works well for measuring raised portions of workpieces. The lowest priced and most compact instrument of its type, the Scratch Depth Gage was designed primarily for the inspection of materials, (wing skins of aircraft, high pressure pipe and tubing, etc.), where scratches exceeding specific limits could result in structural failure. Additional applications include quality control in the metal and plastic industries, measurement of etching depth for photoengraving, etc. Highly precise measurements to an accuracy of plus or minus one ten thousandth of one inch or 5 percent of the depth, whichever is greater, can be made for indentations with depth of from two ten thousandths to sixteen thousandths of an inch; widths from one thousandth to fifty thousandths of an inch can be determined to plus or minus one thousandth. The same range applies to the measurement of raised portions. In addition to depth and width measurements, the gage clearly shows the contour of the indentation. The optical system has been especially designed to fit a lightweight, compactly-sized housing so that the instrument can be carried easily from one plant area to another for various surface inspections. Further portability is due to the fact that the Scratch Depth Gage is battery operated, although a transformer is available for use with 115-V, 50-60 cycle AC power. The Unit, as supplied, is equipped for examining flat surfaces, but the base is easily removable for the



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substitution of special adapters when applications require inspection of rods, tubing or other curved surfaces. During inspection, nylon pads on the base of the instrument provide surface contact and minimize further scratching. A knurled thumb wheel assures precise setting of zero, and the eyepiece is focusable to obtain a sharp, clearly legible image of the line shadow and scale graduations. The instrument has a light gray textured finish, permitting a firm grasp, yet is easy to clean.

* * *

1108—Baird-Atomic, Inc., has added to its line of transistor and semiconductor test equipment with the introduction of the *Model OA-1 Silicon Controlled Rectifier Test Set.* Forward breakover voltage; forward and reverse leakage currents; anode-to-cathode voltage drop, gate firing characteristics, and holding currents may be measured under dynamic circuit conditions. The gate current to fire at any anode voltage may also be measured. The unit contains a continuously controllable power supply of up to 600 volts and a current supply up to 10 amperes. Front panel connections are available for the connection of external gate bias voltages and for the graphic display of voltage and current characteristics on an external oscilloscope. The front panel also contains an interlock jack for the safe and convenient application of high voltage to front panel terminals. Rear panel jacks are provided for additional load resistors. All components of the Model OA-1 Silicon Controlled Rectifier Test Set are conservatively rated for continuous operation at maximum specified currents.

* * *

1109—The *Profilometer* with Peak Counter provides a means by which the average-roughness-height readings and the number of surface irregularity peaks above a preset level can be counted easily and accurately. The development of a means for measuring both peak count and average-roughness-height with a single combination of equipment constitutes a major breakthrough in surface texture measurement and controls. Tests have shown that machined and ground surfaces

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having the same or similar average-roughness-height readings may have a wide variation in the number of peaks producing this average reading. The Profilometer with Peak Counter can be set to read only the average-roughness-height or to read the surface irregularity peaks simultaneously with the average-roughness-height. The instrument is portable, rugged, and easy to operate.

* * *

1110—An automatic capacitor test set to sequentially measure leakage current in as many as fifty capacitors and provide a record of failures, has just been added to the line of equipment and materials testing instruments offered by Associated Research, Inc. The *Model 8515 Automatic Capacitor Tester Fixture* is equipped with panel lights to indicate the unit under test. In addition, a memory light signals the failure of a unit, and remains illuminated as the automatic test sequence continues. This automatic tester fixture may also be employed to test other components, assemblies and cables with up to fifty conductors. The Model 8514 Automatic Hypot supplies a d-c potential continuously adjustable from 0 to 20 kv for capacitor testing. A motorized control raises the test potential at the rate of 300 Volts per second, to any pre-set value, and then returns to zero. The leakage current measurement ranges are 0-10 and 0-250 microamperes. The heavy duty power supply provides a charging current of 20 milliamperes for rapid testing of capacitors.

* * *

1111—A new Transfer Oscillator Synchronizer which permits frequency measurement up to 12.4 gc with accuracy up to 3 parts in 10^8 or better has been announced by Dymec, A Division of Hewlett-Packard Co. The new device is used with a transfer oscillator and an electronic counter to provide simpler, more accurate and more useful frequency measurements from 200 mc to 12.4 gc. The *Model DY-5796 Transfer Oscillator Synchronizer* provides positive locking of the transfer oscillator to the signal frequency. Thus, the hand tuning normally associated with transfer oscillator techniques is eliminated, and measurement accuracy becomes equal to that of the counter time base. Accuracy of 3 parts in 10^8 is obtained with the internal time base of counters such as the Hewlett-Packard Models 524C or 524D; even greater accuracy can be obtained using an external time base. The Transfer Oscillator Synchronizer also permits long term measurements of low drift rates at microwave frequencies, and simplified measurement of FM deviations up to ±0.2 per cent.

1961 Membership Roster

Plans are now being made for printing the 1961 Membership Roster, to be available for distribution during November.

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NEW LITERATURE

1130—The new *1961 Chemical Order Book* for education institutions has just been published by Central Scientific Co., Chicago. The 24-page book contains an alphabetical listing of the varous chemicals, reagents, solutions, biological stains, culture media and indicators which are in the greatest demand for educational and industrial laboratories.

* * *

1131—A *four page bulletin* entitled "Precision Granite Surface Plates and Straight Edges", gives detailed reasons for selecting Granite when accurate, non-magnetic, suction-free, rustproof, warp resistant, temperature resistant and non-abrasive qualities inherent in this material are required. This bulletin has been devised to offer a quick look at several of the many Ottavino Granite applications, manufactured and guaranteed to an accuracy of 0.00005 of an inch on plates up to 24 by 30 inches.

* * *

1132—A six page *bulletin (No. 21130)* describing the capabilities of the Type 21-130 Laboratory Mass Spectrometer is now available from the Analytical & Control Division of Consolidated Electrodynamics Corp. The 21-130 is a cycloidal focusing mass spectrometer utilizing a cycloid tube with 1.1 inch focal distance and a permanent magnet charged to approximately 4500 gauss. Unit resolution is attained at mass 200 with usable resolution to at least mass 230.

* * *

1133—A *new brochure,* just published by Twin City Testing Corp., introduces the Type EC Permascope for non-destructive measurement of (1) a non-conductive coating on a non-ferrous base metal such as aluminum or copper, (2) a non-ferrous coating on a non-ferrous base, (3) a non-ferrous coating on a non-conductor, and (4) conductivity of a non-ferrous metal. As well as containing descriptive information, specifications and prices for the new instrument, the brochure includes details on Type ES Permascopes for gaging coatings on iron and steel plus a technical discussion of non-destructive thickness testing.

* * *

1134—Standard *specification sheets* and a listing of physical and chemical test methods for kraft and glassine electrical insulating papers have been published by Minnesota Mining and Manufacturing Co. The specification sheets show such characteristics as caliper, density, conducting particles, moisture content, dielectric strength, ash content, pH water extract, basis weight and coverage. The physical and chemical test methods sheet lists formulas used in calculating specifications. Sheets are available for both "Insulglass" (formerly Gotham Electric) and

#8 "Coiltronic" (formerly #8 Coil Kraft) electrical insulating papers.

* * *

1135—The *Swanson V-Liner Inspection Unit*, is graphically described in a new four-page, two-color bulletin. The inspection unit, which incorporates six standard inspection devices is one integrated package, is a compact (60 x 12 inches, or 60 x 24 inches), convenient surface plate that readily accepts quickly attached accessory devices. Pictured in the bulletin are many patented features including concentricity checking attachment for shafts up to 50 inches long, adjustable bench centers for shafts up to 48 inches long, V-blocks with 7¼ inch diametral capacity, a sine bar attachment for checking tapers and angular pieces, and an attachment for rigidly clamping all types of shaft-checking indicators. All attachments are positively positioned on either ground or scraped surface plates equipped with patented positioning rail.

* * *

1136—Quick, accurate analysis of acid gold alloy plating solutions obtained by polarographic methods are described in a *3-page paper* by Dr. Karl Schumpelt and Arnold H. Craft of Sel-Rex Corporation. Originally presented to the American Electroplating Society, Newark Branch, and published in *Plating Magazine*, this paper has been reprinted as a technical service by Sel-Rex for electroplaters who must meet or exceed exacting government and industrial specifications requiring precise control of acid gold alloy electroplate. The authors describe in detail the development of a polarographic method for testing and evaluating acid gold alloy electrodeposits, giving graphs, formulas, and specific examples. Their paper also gives a table comparing results of polarographic and standard analytical methods, and lists notes for further reference.

* * *

1137—Detailed information on its line of disc indicators used in measuring and control systems employing resistance strain gage transducers is contained in a bulletin offered by Electronics & Instrumentation Division of Baldwin-Lima-Hamilton Corp. The *six-page bulletin* includes specifications, connection details, diagrams showing typical system applications and a convenient disc indicator selection chart.

* * *

1138—*A four-page technical brochure*, available from Power Instruments, Inc., describes the new "super-sensitive" model 783 Oz-Torqmeter. This instrument reads both static and dynamic torques in the 0.1 to 5.0 Gm-Cm ranges. The folder contains specifications, operation, prices, and application data.

NOW...FROM WINSLOW

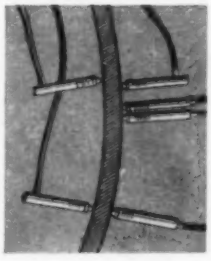
New electronic gaging systems

CUTS READING ERRORS

NO RECORDING ERRORS

NO VISIBILITY PROBLEMS

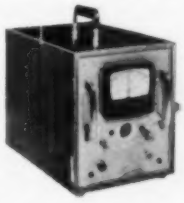
CUTS ACCESS PROBLEMS



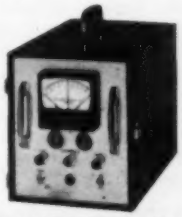
Uses Winslow Electronic Gaging Probes—sensitive transducers that substitute for standard dial indicators and most air probes in any mechanical "design" gage. Small size of the Probes (3/8" dia. x 2-13/32") allows locating check points where never possible before. Probes can be completely hidden. Console CS-24 (above) shows gage position and variation in lighted numerals 1" high, also prints this information on tape, card or sticker if desired. Push proper button to check any individual point, or machine automatically reads up to 24 gage positions and prints the results. Also reads "thickness" variation between any two opposed Probes. Accuracy possible to nearest .0001". Versatile—use with any number of "design" gages. Write for literature.

ALTERNATE READOUT DEVICES

Model IN-27 reads out a single Probe on meter scale. Can operate automatic sorting devices, etc. Can be ganged to read multiple points simultaneously.



Model LP-9 Electro-Chek* reads each of 9 Probes on the meter as you touch the button. Lighted digital lamp identifies gage position. Optional limit pointers.



Model LP-18 Electro-Chek* reads up to 18 contour points. Also reads "thickness" variation between any two opposed Probes. Compact. Versatile.

*T.M. Winslow Mfg. Co.

ACCURACY THROUGH ELECTRONICS

WINSLOW MANUFACTURING CO.

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section briefs

ALBANY . . . The Executive Committee met August 31 to finalize programs for the 1961 to 1962 season. From preliminary reports it appears that a very fine program is being formulated for the section.

On Nov. 14, Dr. A. V. Fiegenbaum, a charter member of the section, will address our group. This will mark the 10th anniversary of the founding of the section.

K. W. Trevithick

ALLENTOWN-BETHLEHEM . . . In an attempt to draw more attention to our section, Marsh Warner, newly appointed local publicity chairman, has spent a great deal of time preparing colorful posters. These were strategically placed on plant bulletin boards in our area.

We are heartened by a rush of advance registrants reported by Vince Lukach, education chairman for the "Design of Experiments" course at Muhlenberg College. Atlas Chemical Company alone is sending eleven students.

The late summer efforts of our membership chairman, Russ Bodnyk, harvested a crop of new members and renewals. The new faces are welcome and the old friendships continue to grow.

R. Horstman

BATTLE CREEK-KALAMAZOO . . . An executive committee meeting was held at the home of chairman Eugene E. Conolly in Battle Creek on Aug. 10 to continue plans for the coming year.

Our second annual forum, held in cooperation with Western Michigan University, will be conducted on Saturday, Mar. 24, 1962.

We will again have a fall course, the theme this season . . . "Sampling Methods in Quality Control." Assistant Professor Roy W. Groulx of W.M.U. will be in charge.

Mr. Guy Benson of the Upjohn Co., Kalamazoo, will chair the By-laws Committee for our section this year.

Peter F. Koets

BOSTON . . . A new feature this year are four non-dinner meetings. These meetings, to be held at the Hornblower Room, Boston Museum of Science, will augment the regular monthly gatherings.

William E. Grady

CHICAGO . . . The second meeting is truly timely. We have scheduled a great speaker in Thomas D. Harrison, of Albuquerque's Sandia Corp. His talk will be on "Computer Applications of Quality Control." He intends to talk on data processing from the customer or user point of view. The slant will be definitely quality-control oriented.

C. B. Herschberger

CINCINNATI . . . Analysis techniques will be the feature of both the November and December programs. Members will have the opportunity to learn a new and simple analysis tool on Nov. 15 when Ervin F. Taylor speaks on a "Frequency Distribution Sheet."

Martin Medow

CLEVELAND . . . The annual all day conference of the section is slated for Nov. 10. The conference will close with the regular monthly meeting which will be in the form of a panel discussion. The moderator will be A. V. Feigenbaum of General Electric.

N. A. Burkhardt

CORNING-ELMIRA . . . Our executive committee meeting was held at the Corning Glass Big Flats Plant on Aug. 31. The topic of discussion included membership, education, evening programs, publicity and finance. All of these subjects centered about the Corning-Elmira section's goal — to win the Saddoris Award.

Allan Erny

GREATER MUSKEGON . . . On Nov. 9 the Greater Muskegon section will have Wilbur Myers as guest speaker for the evening. Mr. Myers is director of quality control at Delco-Remy Div., GMC. His topic will be "Human Relations Involved in Instituting a Quality Control Program." The meeting, to be held at Bill Stern's Steak House, will begin promptly at 6:30 pm.

As part of the Greater Muskegon section's educational program for the 1961-62 year, two courses in quality control by statistical methods are being given. The basic course, which started Oct. 9 and will continue through Nov. 13, is a six-week course. The intermediate course, which is for eight weeks, will start Jan. 8, 1962, and continue through Feb. 26. The instruction in both courses is in the very capable hands of W. A. Poe of John Wood Co. and E. J. Fortenbacker from Standard Automotive Parts Co.

Al Baker

HARRISBURG . . . The executive committee met at the Hamilton Watch Co., Lancaster, on Aug. 14. E. Kern, education chairman, announced that his committee had secured meeting places for two of the section courses. The basic course will be presented at Schick, Lancaster, and the intermediate course will be held at the Caterpillar Tractor Co. at York. The first will be held on Monday nights and the latter will be held on Thursday nights, with J. T. Skelton as instructor. A third, or advanced course, will be conducted on Monday nights with Ervin Taylor, Martin Co., Baltimore, as the instructor. The time of this course is still to be confirmed.

The membership chairman, D. C. Connor reported his committee is attempting to get wider company representation in this area and will send out information to a cross-section of manufacturers not affiliated with ASQC. Renewals have been coming in with better than 50 per cent of the membership represented as of September 1.

Ann Englehart

HARTFORD . . . Executive committee meeting was held at Ken Martin's (junior past chairman) home Aug. 25. A hearty dinner was served . . . The committee thanks the Martin's for their hospitality.

Guest speaker for the Nov. 14 meeting will be Mr. Peter Carbone of Brown and Sharpe Mfg. Co., Providence, R.I. His subject will be "Operation of Electronic Gauges." This meeting, and all future ones, will take place at Red Coach Grill on the Berlin Turnpike, Newington.

E. May

INDIANAPOLIS . . . At the president's recognition dinner (Aug. 24, Riviera Club) president Blackburn welcomed more than 40 members and their wives. Among those given recognition for work and responsibilities was *IQC's* editor, Dr. Irving W. Burr, founding member and past president, now co-chairman with Dr. Charles Hicks of Placement for the section. Dr. Burr will be our speaker on Nov. 14.

Another recognized was Dr. Latham Breunig, past Saddoris Award chairman and new executive director, who said he might just mention ASQC for "Points" when he presents a paper at the Association of Official Agricultural Chemists in Washington. Dr. Breunig held

up a watch given him by the Eli Lilly Company for 25 years service. A third was John Waldner, advisory committeeman and secretary of the Midwest Conference Board, who asked, "What can the Board do to help the individual sections?"

H. M. Handerson

IOWA, STATE UNIVERSITY OF . . . Plant tours of the U.S. Gypsum plant at Mediapolis and the International Resistance plant at Burlington are planned for Friday, November 17.

Gayle W. McElrath, University of Minnesota, will be the luncheon speaker at the Hotel Burlington. His topic will be "Sequential Analysis."

John Miller

JOPLIN-SPRINGFIELD . . . On Aug. 3, our Executive Committee met at LeDuc's Dinner House, Mt. Vernon.

One of the major items of discussion was our forthcoming course in SQC. This is by far the biggest project our section has undertaken and educational chairman Stan Straska is doing a great job spearheading it. We will report more on this later.

R. C. Bogart

LEXINGTON . . . Counting the series on quality control in the space age, we are most fortunate to have J. Y. McClure, Jr., past president of ASQC, for our November speaker. The subject — "Reliability in our Missile and Aircraft Program." Mr. McClure is director of reliability and quality control for General Dynamics, San Diego, California.

At the August executive board meeting plans were completed for the course in physical testing methods. After the meeting a practical problem in reliability was attacked by the group as they tested the golf course at the Lexington Signal Depot.

James C. Graff

LIMA . . . On Aug. 13, the second annual section picnic brought 130 members, their families and guests together for games, contests, good eating and fun. All participants deemed the picnic a huge success, from door prize to trip home.

On Nov. 7, the section will enjoy another presentation by the Lima ASQUAC Players. The play is entitled "Curves Can Be Poison," and will be presented in the plush surroundings of Lima's new Holiday Inn. Along with this, the members will view the film "Integrity Plus."

. . . Dec. 5, Ervin F. Taylor, Martin Company, will speak on "Discovery Sampling" at the dinner meeting in the Holiday Inn.

C. J. Dukro

LOS ANGELES . . . Harvey Aluminum will present a panel on Nov. 28. The panel will cover the research and development, metalurgy, and QC requirements necessary to the processing of one of the frequently used raw materials. This is the first panel where the quality of the end product depends purely on process controls which have been established by pure R&D as well as manufacturing methods in which the sequence of processing covers many points which can not be measured mechanically or electrically.

Steve Kozich

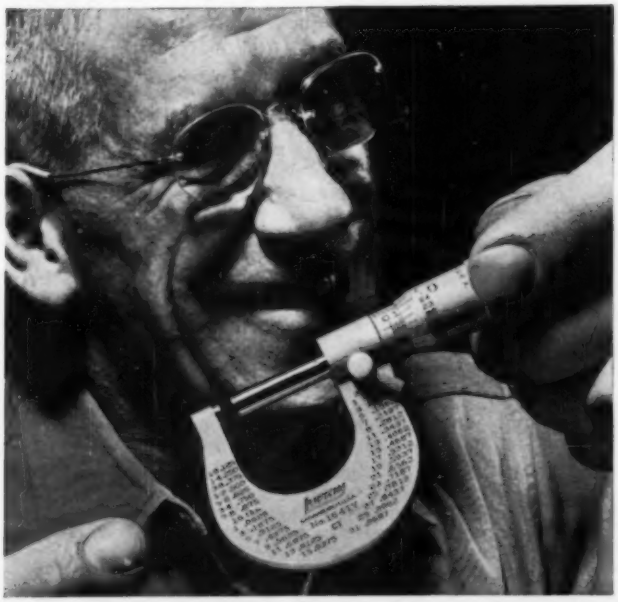
LOUISVILLE . . . Final plans for the printing of the section newsletter, *The Sigma*, were completed at the home of Ray Evans on Aug. 21. The first copy of *The Sigma* was mailed to members, and several members of the industry, on Aug. 29.

Our November meeting will be one of significance. This meeting is labeled "Management Night," to which each member brings his boss as guest of the section. The program will be of interest to our guests, as Spencer T. Jones, Louisville manager of Philip Morris, Inc., will tell of the "Manager's Role in Civic Activities." Mr. Jones is well-versed on this subject due to his many years of active experience with the Kentucky Derby and the State Fair festivities.

Monroe J. Oates

MEMPHIS . . . A meeting of the officers and committee chairman of the section was held Aug. 29 with chairman Raymond L. Ross presiding. Functions and plans for each office and committee were discussed, and a primary

Lufkin micrometers do a better job with fewer parts



That means fewer parts to get out of adjustment. And the one-piece frame and hub simplifies wear adjustment. Gives you greater accuracy, longer!

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The exclusive cam-lock locks setting at a flick of the thumb . . . prevents costly reading errors.

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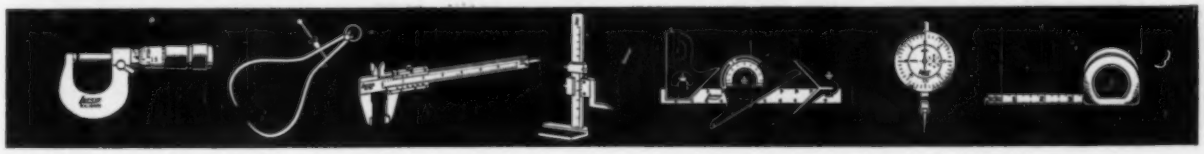

objective to double the membership was set as the motive for all activities.

Douglas W. Ferris

METROPOLITAN . . . In spite of numerous vacation conflicts and the high humidity, the hard-working executive committee has completed the 1961-62 meeting schedule.

S. G. Orban

MINNESOTA . . . This year brings a change in our annual social meeting. We hope that by making the meeting place closer to home and the hour of the meeting later we can bring out more members and their wives or friends. This is a wonderful opportunity to become better acquainted with your fellow members and to make plans to meet them at sessions during the coming year.

Corrinne Leko

NEW HAVEN . . . New section officers are: chairman—Henry S. Pianka, Dow Chemical Co.; vice chairman—Robert R. Jones, Olin Mathieson Chemical Corp.; secretary—Ludwig A. Short, Sargent Co.; treasurer—Richard J. Seegert, Ramset Fasteners, Inc.

Joseph F. Panszak

ORANGE EMPIRE . . . The August dinner meeting at the Waterwheel Restaurant had as featured speaker William F. Hurst, President of Pacific Scientific, who spoke on the subject, "Quality Problems in a Small Company."

Mr. Hurst gave an off-the-cuff" talk pertaining to his own company and the experiences they have had in organizing and establishing the business, and the methods employed to control a quality product. Many of the experiences were humorous and some were heartbreaking. His talk was thoroughly enjoyed by all.

Mr. Hurst is a charter member and was the first vice chairman of this section. Prior to his association with Pacific Scientific he held the position of director of quality control, Leach Corp.

Henry W. McKee

PARKERSBURG . . . On Aug. 24, this section started the season with a barbeque, followed by a meeting, at the home of Ed Albrecht, our chairman for 1961-62. Eight industrial plants in the mid-Ohio valley were represented: Silicones Division of Union Carbide, Sisterville, W. Va.; Olin Mathieson, Hannibal, Ohio; Corning Glass, du Pont, American Viscose, Union Insweating Co., Carborundum Metals, Marbon Chemical, all of Parkersburg. Plans for future meetings were discussed and old acquaintances renewed.

Robert R. Stewart

PENSACOLA-MOBILE . . . The 1961-62 executive committee met Aug. 24 to discuss the complete program and activity plans for the coming season. After the summer period of relative inactivity the results of this meeting point toward an extremely interesting and stimulating series of events. This will be our fourth year as a section and it is the general feeling that this season will be as good or better than ever.

All members are urged to attend our Nov. 16 meeting. Sidney Fielden of IBM will speak on "Statistical Dimensioning."

David A. Haddock

PEORIA . . . On June 30, the Peoria subsection ceased to exist, and in its stead, with the official sanction of ASQC, the Peoria section was born. This new section, with some ninety members, has chosen as its officers: Al Boerckel, chairman; H. M. Braden, vice-chairman; E. M. Politzer, secretary-treasurer; H. S. Johnson, program chairman. The officers, with the exception of H. S. Johnston, of Armour and Company, are with Caterpillar Tractor Company of Peoria.

As a full section and with increasing membership we look forward to a stimulating and challenging future.

R. H. Greenan

RHODE ISLAND . . . A planning session held Aug. 28 for the purpose of finalizing the 1961-62 education program was highly successful. Registration for the fall course in basic quality control is already ahead of last year, according to Education Chairman Win Hamblett. This course will be given by the University of Rhode Island Extension Division as a part of their certificate program. Instructors and course materials are supplied by the section.

Paul K. Moffat

SACRAMENTO . . . Our Nov. 15 meeting will consist of a plant tour of the Campbell Soup Co. and a quality control film presented under the direction of W. S. Crowley — plant manager, D. M. Larkin — plant technologist, and W. Mickialites — supervisor of container quality control.

M. K. Walker

SAN FRANCISCO . . . Dr. Gerald Lieberman, Professor of Industrial Engineering and Statistics, Stanford University, will speak at the section's December meeting on "Some Recent Developments in Sampling Inspection," bringing us up to date on this important aspect of quality control.

We would like to welcome back to the bay area Earnest Shirse, who has for the past two years been stationed at Vandenberg Air Force Base as manager of quality assurance — Pacific Missile Range for the Lockheed Missile and Space Co., and also to wish him much success in his new venture as manager of satellite systems QA requirements and specifications.

Thomas Russell

SANTA MARIA-VANDENBERG . . . No regular monthly meeting was held during August; however, a committee meeting was held on Aug. 22 for further planning for the coming season.

We are looking forward to Glen E. Gormley's talk this month, rather than, as previously announced, for the October meeting. Mr. Gormley is manager of management research for the Cannon Electric Co., Los Angeles. Demand for Mr. Gormley's services and a rather hasty assumption on our part necessitated this rescheduling.

Victor E. Johnson

SEATTLE . . . A planning session was held by the executive committee on Aug. 29. Chairman Gordon Siddons introduced the officers and committee chairmen present and briefly discussed the duties of each office.

Available in Reprint Form

The Basic Work Elements of Quality Control Engineering

This reprint is designed to serve as the foundation for building the professional stature of ASQC. It provides a much needed guide for Quality Control Engineers and Industrial Management in establishing and guiding their quality control programs. Colleges and Universities will be able to utilize this information in the development of future curricula.

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ORDERS MUST BE ACCOMPANIED WITH YOUR REMITTANCE

Officers for the coming year are: chairman—G. J. Siddons; vice chairman—G. L. Haberly; secretary—J. A. Filchak; treasurer—J. R. Levesque.

James J. Whyte

SOUTHERN CONNECTICUT . . . Our Nov. 14 meeting at the General Electric Institute in Bridgeport will be a joint meeting with the New Haven section. Our guest speaker will be William H. Harrel, chief of the quality evaluation section, quality division, National Aeronautical and Space Agency. He will speak on the "Vendor-Vendee Program at the Marshall Space Flight Center."

William E. Wells

SYRACUSE . . . The first executive committee meeting was held on Aug. 29. The excellent attendance was an indication of a "real get-up-and-go" organization with a barometer reading of good weather ahead.

The program scheduled is well balanced with interesting topics and speakers in the offing. The Nov. 14 meeting will feature Kenneth W. Davidson of Texas Instruments whose topic will be "Reliability in Production."

F. A. Bullard

TOLEDO . . . Mr. George H. Barrows, chief inspector, M & S Morenci Corp., will moderate "Machine Quality Capability Studies," a talk to be given at the Nov. 2 meeting by Irwin DeGrote, Ford Motor Co.

The second annual one-day conference will be held Saturday, Apr. 14, 1962, at the Hillcrest Hotel, according to Theodore R. Meyer, conference chairman. Assisting will be Joseph A. Ivan, arrangements; Keith L. Lewis, program; and Hilton C. Fetting, publicity.

Membership chairman Paul E. Smith reports that all 1960-61 members have renewed their membership for the coming year. As of Aug. 15, the Toledo section had increased to 112 percent of the June 30 membership.

Members, wives, and guests are invited to attend the annual Christmas party to be held on Dec. 8 at the N.Y.C. Sportsmen's Club, South Byrne Road.

R. E. Rockwell

WACO . . . On Nov. 12, the section will hold its monthly meeting at the Elite Steak House. There will be a meal served at 6:30 pm, with the meeting starting at 7:30 pm. The speaker will be R. S. Bingham, and his subject will be "Bulk Sampling Problems — What to Do."

The period from Nov. 1 to Nov. 27 will cover the last five weeks of the school the section has planned on "The Basic Concepts of QC." The chairman of this training will be D. H. Barrett, and the course will be held once a week in the Hankamer Bldg., Baylor University. Each session will last two hours.

J. L. Tankersley

WESTERN MASSACHUSETTS . . . On Tuesday evening, Nov. 14, Albert M. Dexter, director of metrology, Pratt & Whitney Co., Inc., West Hartford, Conn. will be the guest speaker. His subject will be "Zero Point One," which covers the National Bureau of Standards' program to develop ultra-precise gauge blocks. The meeting is to be at the Sheraton Motor Inn, Springfield, with the speaker scheduled for 8:00 pm; dinner will be at 6:30 pm.

Alan J. Donnelly

WINNEBAGO . . . Newly elected and appointed officers of the section are: chairman Carl Matson, technical director of Gilbert Paper Co.; vice-chairman Jim Penrod, supervising control chemist, Rahr Malting Co.; secretary-treasurer John Kruger, assistant coating superintendent, and immediate past chairman Bill Haselow, quality control supervisor, both of Consolidated Water Power and Paper Co.; membership chairman Andy Blackburn, quality director, Appleton Mills. The officers acting as the executive committee met on Aug. 29 to lay out the program for the 1961-62 season. Plans include training sessions before dinners, and evening speakers. A workshop meeting and a mill visit are also on the agenda.

Andrew F. Blackburn

WORCESTER . . . Since basic QC training courses have been so successful, it has been decided to offer a course on gauges and gauging to assist Worcester area industries in their training efforts.

Worcester member Axel U. Sternlof travels to Montreal to present his interesting program.

G. F. Anderson

YOUNGSTOWN . . . Mr. Bingham's subject on Nov. 2 should be of interest to many members and their coworkers. In the Youngstown area there are many plants which receive, process and ship multi-ton quantities of materials and products. "Bulk Sampling Problems — What to Do" should be of special interest to all involved with this problem.

Eugene Passell

Howard J. Kerans, Jr.

The Worcester section regretfully reports the death of Howard J. Kerans, Jr. as a result of an automobile accident. Howard was quality control engineering supervisor for timer production at the Ashland, Mass. plant of General Electric. He was 1959-60 section secretary-treasurer.

Los Angeles Section Picks 'Man of the Year'

The Los Angeles section recently made its annual selection of a "Man of the Year." This year's choice was J. Y. McClure, ASQC junior past president.

Los Angeles section officers stated that Mr. McClure had "shown leadership and ability in his term as national president. He . . . improved the professional status of quality control, and at the same time, provided the skilled inspector with a national division and workshops at many quality control conferences."

At the time of his selection, "Mac" was manager of quality control for Convair Division of General Dynamics Corp., Fort Worth, Texas. On Sept. 1 he was appointed director of reliability and quality control, General Dynamics Corp., San Diego, Calif.

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SECTION CALENDAR (NOVEMBER 1 TO DECEMBER 10)

SECTION	DATE	PLACE	TIME	SUBJECT	SPEAKER
Albany	Nov. 14	.....	8:00 p.m.	Before and After	Dr. A. V. Feigenbaum
Albuquerque	Nov. 13	.....	.....	Tests of Significance in Industrial Processing	G. C. Parkin, Staff Consultant, Minnesota Mining and Mfg.
Allentown-Bethlehem	Nov. 8	Hotel Traylor	8:00	Controlling Plating Processes	Robert Steinmetz
Battle Creek-Kalamazoo	Nov. 16	M.S.U., East Lansing, Mich.	8:00	.....	James Barabee, Hoover Ball and Bearing Co.
Boston	Nov. 9	M.I.T.	.....	New Horizons for QC	H. Dean Voegtlen, RCA
	Dec. 6	Science Museum	.....	Process Control	Dave Polamountain, Aerovox
Buffalo-Niagara Falls	Nov. 27	Executive Hotel, Genessee St., Checktowaga	6:30	Design & Analysis of Life Testing Experiments	John H. R. Kao, Cornell University, Ithaca, N. Y.
Chicago	Nov. 15	Chicago Furniture Mart	5:30	Computer Applications in Quality Control	T. D. Harrison, Sandia, Albuquerque, N.M.
Cincinnati	Nov. 15	Engineering Society Bldg.	6:30	Frequency Distribution Analysis Sheet	Ervin F. Taylor, The Martin Co.
Cleveland	Nov. 10	Cleveland Engineering Soc.	8:00	QC Management & You, a panel discussion	A. V. Feigenbaum, G. E. Moderator
Grand Rapids	Nov. 12	Varsity Grill	7:00	Question the Question	A. F. Gordon, John Wood Pump Co.
Greater Muskegon	Nov. 9	Bill Stern's Steak House	6:30	Human Relations Involved in Instituting a Quality Control Program	Wilbur Myers
Harrisburg	Nov. 1	York, Pa.	6:30	Reliability, a Management Challenge	W. A. MacCrehan
Hartford	Nov. 14	Red Coach Grill	6:30	Electronic Gauging	Peter Carbone, Brown & Sharpe Mfg. Co.
Indianapolis	Nov. 14	Atherton Center, Butler Univ.	7:30	Probabilities—Principles and Problems	Dr. Irving W. Burr
Lexington	Nov. 16	Lexington Signal Depot	7:00	Reliability in Our Missile and Aircraft Program	J. Y. McClure, General Dynamics Corp., San Diego, Calif.
Lima	Nov. 7	Holiday Inn	6:30	Management Night	.....
	Dec. 5	Holiday Inn	6:30	Discovery Sampling	Ervin F. Taylor, The Martin Co.
Los Angeles	Nov. 28	IAS Bldg., 7660 Beverly Blvd.	6:00	Clinic Session	H. Merritt, Automatic Screw Machine Div.
			7:00	Harvey Aluminum Panel	Panel members
Louisville	Nov. 13	Hasenour's	6:30	A Manager's Role in Civic Activities	Spencer T. Jones, Philip Morris, Inc., Louisville
Memphis	Nov. 7	.....	8:00	Conscience of a Company	H. B. Epstein, Vought Electronics Div., Dallas, Texas
Metropolitan	Nov. 15	Hotel Martinique	7:45	Quality Engineering's Role in Product Development	Ted Schultz, General Electric Company
				Putting Quality Data to Work	Ralph Fleishman, R. Fleishman Company
Minnesota	Nov. 14	American Legion Post, 66th & Portland	7:30	QC on Regression Co-efficients for Electronic Components	Eugene A. Johnson, Univ. of Minnesota
	Dec. 5	Whirlpool Corp.	1:00	Plant Tour	.....
Orange Empire	Nov. 7	Waterwheel Restaurant, Anaheim	7:15	Purchasing and Quality Control	Harry Kay
Pensacola-Mobile	Nov. 16	Brookley AFB	6:30	Statistical Dimensioning	Sidney Fielden, IBM
Rhode Island	Nov. 16	Providence Engineering Soc. Bldg.	8:00	New Approaches to Reliability	Dorian Shainin
Sacramento	Nov. 15	.....	7:00	Plant Tour of Campbell Soup	.....
St. Petersburg-Tampa	Nov. 13	St. Petersburg Jr. College	8:00	.....	R. W. Anderson, Semi Conductor Div., Texas Instruments, Inc. Dallas, Texas
Salt Lake	Nov. 23	Maw & Paws	7:00	.....	.....
San Francisco	Nov. 14	.....	6:00	Some Recent Developments in Sampling Inspection	Dr. Gerald S. Lieberman
Santa Maria-Vandenberg	Nov. 14	Las Flores Inn, Santa Maria	7:00	Statistical Implications in Designs of Experiments	Glen E. Gormley
Seattle	Nov. 14	Richland	.....	Joint meeting with Tri-City Subsection	.....
Southern Connecticut	Nov. 14	General Electric, 1285 Boston Ave., Bridgeport	8:00	Vendor-Vendee Program at the Marshall Space Center	William H. Harrel, NASA
Syracuse	Nov. 14	Turner's	6:30	Reliability in Production	K. W. Davidson, Texas Instruments
Toledo	Nov. 2	EST Club Rooms, 4638 Lewis Ave.	6:30	Machine Quality Capability Studies	Irwin DeGrote, Ford Motor Co., Dearborn, Mich.
	Dec. 8	NYC Sportsmen's Club, South Byrne Rd.	8:00	Christmas Party	.....
Toronto	Nov. 8	C.G.E. Auditorium, 214 King St., W.	7:45	.....	C. J. Stone
	Nov. 22	C.G.E. Auditorium, 214 King St., W.	7:45	.....	H. C. Hildreth
Tulsa	Nov. 21	French Room, Borden's Cafeteria	6:30	Statistical Procedures for Determining Validity of Suppliers' Attributes Inspection	Lt. Col. W. S. O'Connor, U.S. Army Ordnance District
Waco	Nov. 7	Hankamer Bldg., Baylor University	7:00	Basic Concepts of Quality Control	D. H. Barrett, Chairman
	Nov. 13	Elite Steak House	6:30	Bulk Sampling Problems—What to Do	R. S. Bingham
	Nov. 14	Hankamer Bldg., Baylor University	7:00	Basic Concepts of Quality Control	D. H. Barrett, Chairman
	Nov. 21	Hankamer Bldg., Baylor University	7:00	Basic Concepts of Quality Control	D. H. Barrett, Chairman
Western Massachusetts	Nov. 14	Sheraton Motor Inn, Springfield	6:30	Zero Point One	Albert M. Dexter, Pratt & Whitney Co., Inc., West Hartford, Conn.
Winnebago	Nov. 20	Appleton Elks Club	5:15	Training session and dinner	.....
Worcester	Nov. 16	Nick's Grill	7:00	Zero Point One	Albert M. Dexter
Youngstown	Nov. 2	Astoria Cafe, Warren, Ohio	6:30	Bulk Sampling Problems—What to Do	R. S. Bingham, Jr., Carborundum Company, Niagara Falls, N.Y.

SIGNIFICANT DIFFERENCES

. . . ALLENTOWN-BETHLEHEM — **Irv Yeager** has been assigned to reliability function quality control at Allentown Works, Western Electric. We note with pride that our section treasurer, **Bob Tust,** spoke to the Western Massachusetts section on "Graphic Analysis of Experimental Design." Our education chairman, **Vince Lukach,** presented a paper at Rutgers on "Statistical Methods Help Solve a Glass Shrinkage Problem."

. . . BATTLE CREEK-KALAMAZOO — Two of our section members, both from KVP-Sutherland Paper Co., have received promotions as of Sept. 1. **E. E. Stephenson,** quality director, has been promoted to production services manager, and **Clarence Oranje** (our 1960-61 chairman), chief quality supervisor, has been promoted to quality director.

. . . BOSTON — **George Mason,** supervisor of inspection, Hersey-Sparling Meter Co., has been promoted to chief of quality control and inspection.

. . . CHICAGO — The reliability course put on by the Electronics Division, ASQC, and IRE in Chicago, has been postponed until the first of the year. An outstanding instructor and a marvelous outline have been selected.

. . . CINCINNATI — **Jack Kirby,** quality engineer at the Cincinnati Plumbing & Heating Div. of American Standard, has been transferred to their Louisville, Ky. plant. **Alfred May,** National Lead, replaces Jack as program chairman for the annual all day conference to be held Jan. 27.

. . . HARRISBURG — **J. Walbrecht,** Raybestos Manhattan Inc., Manheim, Pa., who is currently serving as the publicity chairman, was married on July 1. Congratulations!

D. C. Connor, chairman of our membership committee, was recently appointed to the position of quality manager for the Hamilton Watch Co., Lancaster, Pa.

Marriott Fasnacht has been appointed by Dr. John L. McLucas, President of HRB-Singer, Science Park, State College, Pa., to head the corporate-wide quality control program instituted July 10.

. . . INDIANAPOLIS — **Ted Meserve** is a new director of the Midwest Conference Board.

. . . IOWA, STATE UNIVERSITY OF — Secretary-Treasurer **E. D. Stambaugh** has resigned by reason of his transfer to Collins Radio Co., Toronto, Ont. **Paul L. Piskel,** Collins Radio Co., Cedar Rapids, has been appointed to take the place of Mr. Stambaugh. The job of membership chairman goes to **L. C. Byrd,** General Electric Co., Morrison, Ill.

. . . JOPLIN-SPRINGFIELD — Vice chairman **Tom Blair** of Eagle-Picher Co. has been promoted from product quality supervisor to quality control engineer. He succeeds **Don Lawson,** junior past chairman, who also received a promotion. Treasurer **Roy Lowrey** of Vickers, Inc., has also been promoted recently.

. . . LOS ANGELES — **Bill Drees** has become a member of the reliability staff at Amphenol Western Div.

Dr. Harry G. Romig, previously senior scientist and staff member of Operations Research, Inc., has been named corporate director of quality engineering of Leach Corporation, Los Angeles, with primary emphasis on activities of the Leach Relay Division.

Dr. Romig is an international authority on sampling, quality control, reliability, operations research, industrial engineering, and management science. He started his research and development work in these fields at Bell Telephone Laboratories, with which he was associated for over 24½ years.

He is founding member and Fellow of ASQC and is serving this year as conference chairman for the Western Regional Conference.

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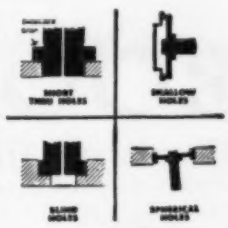

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E. J. Lancaster has taken a position as director of quality control with AMF.

. . . METROPOLITAN—**Nick Pavacich** (Bell Telephone Laboratories) has accepted the responsibility for reporting the activities of the rapidly expanding Long Island subsection.

. . . MINNESOTA — **Ken Rose** moved from the Applied Math and Statistics Department to the Data Processing Center at Minnesota Mining and Manufacturing Co.

. . . PENSACOLA-MOBILE — **L. R. Henry** and **C. C. Mitchell** were promoted from quality control engineers to senior quality control engineers for the Chemstrand Corp.

S. L. Walters was promoted from analytical service superintendent to superintendent, quality control for the Chemstrand Corp.

. . . SACRAMENTO — The most significant difference recently occurred in the home of the **Loyd Rowes**, when they welcomed a new son into the fold. Congratulations are in order. We understand Loyd is recovering rapidly.

. . . TOLEDO — **Robert E. Passino** has been appointed quality control manager at the Textileather Division of the General Tire and Rubber Co.

. . . WACO — The Waco section would like to acknowledge the assistance of **Dr. A. S. Lang**, Dean of the Hankamer School of Business at Baylor University, in helping the section to obtain a classroom for their training classes, in the newest and most modern building on the Baylor University campus.

. . . WINNEBAGO — **Bill Haselow**, Consolidated Water Power and Paper Co., has been promoted from quality control engineer to quality control supervisor.

. . . WORCESTER — Two of our section members are conducting QC courses at Worcester Junior College — **Axel Sternlof** is teaching Advanced QC and **Arthur Pingalore** is teaching Basic QC.

BOOK REVIEWS

Charles R. Hicks, Editor

Purdue University, Lafayette, Ind.

STATISTICS FOR BUSINESS DECISIONS by Ernest Kurnow, Gerald J. Glasser, and Frederick R. Ottman. Published by Richard D. Irwin, 1959, xii-524 pages, $7.75. Reviewed by William H. Andrews, Indiana University.

This is an outstanding textbook, combining originality of approach with workmanlike competence of presentation. In an era when the drive to publish, facilitated by technology and ready-made markets, creates business literature by the ton, even the most charitable observer may wonder why many "new" textbooks ever see the light of day. Regardless of the standards established for justification of a new text, however, the present book would be likely to meet them.

The approach adopted here is that of heavy emphasis on the inference aspects of statistics. This means, for one thing, that it is a text for mature students, even though it is intended to serve as an introduction to the subject. Many, or most, of the beginning undergraduate courses in business and economic statistics would therefore find the book heavy-going, to say the least. It means, also, that the approach in itself is not unique, as a number of other texts have been designed along very similar lines. The uniqueness lies, in this reviewer's opinion, in the fact that none of these others have done the job quite as effectively. Finally, it means that certain of the more traditional elements of an introduction to statistics have been either soft-pedaled or omitted. This is unfortunate from the point of view of developing students well grounded in the fundamentals of descriptive statistics, but it is a deficiency not too difficult for the instructor to correct, according to his own lights, in the classroom. For those who feel that the current vogue of making inference theory the main chunk of elementary economic statistics is misguided, this book, like some others of the more recent texts, will seem quite unsatisfactory.

One of the most commendable features of this book is the extensive use of interesting illustrative materials from the field of business and economics. The excellence of these examples is indicative of the very considerable effort and thoughtful planning that must have gone into the book's preparation. At the end of each chapter there is a helpful summary along with questions designed to test the student's ability to apply the methods and principles which he has studied. In addition to the questions in the text itself, a very good *Workbook* is supplied by the same authors to be used in conjunction with the text.

Another strong point is the care taken in defining terms and in specifying the assumptions underlying the methods described. If one feels at times that some of the fine distinctions in terminology—as, for example, between testing and estimation problems, and between enumerative and analytical studies—fall a little flat, that is perhaps more a criticism of the state of statistical science, or of science generally, than of this particular exposition. Regardless of ultimate merit, these definitions are thought provoking to both student and teacher. Likewise the attempt to define α as the risk associated with that type of error which one is most anxious to avoid and to require that the null hypothesis be set up so that α will be the risk of rejecting H_0 erroneously, leads to some slight inconsistencies. The formulas on page 241,

$$p^* = \pi_0 + z_\alpha \sqrt{\frac{\pi_0 (1 - \pi_0)}{n}}$$

and

$$n = \pi_1 - z_\beta \sqrt{\frac{\pi_1 (1 - \pi_1)}{n}}$$

for determining p^* and n, are correct only if π_0 happens to be the lower of the two proportions used in formulating the particular decision rule since clearly the rejection-point will be between π_0 and π_1. And in the chapter on the control chart, the authors follow convention in designating α as the risk of taking action on the process if no trouble exists, without any very satisfactory effort to reconclie this with their earlier treatment of α.

There are some significant omissions in the book—at least from this reviewer's viewpoint. The most important of these is the whole subject of index numbers. The authors would no doubt plead that the book is already long and that this subject is not too well integrated with the approach that they have chosen. This reviewer also feels that time series analysis is deserving of more emphasis than it receives here—and the authors' reply would probably be the same as for index numbers. Some statisticians will think that the handling of the "t" distribution is inadequate, but the status granted it may well be all that it really deserves in terms of its proper applicability to economic problems. Finally, some may believe that, having gone as far as they have in stressing the decision-making process, the

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authors should not have omitted entirely the Bayesian techniques which are of such great current interest in this field.

On the other hand, there is some question as to the usefulness of computations of the mean and standard deviation for coded variables presented in Chapter 10 and of the brief discussion of analysis of variance in Chapter 12.

The critisisms offered here simply demonstrate, for the most part, that no textbook can please all of the people all of the time. The reviewer has used this textbook successfully (he hopes) and is going to use it again. Student reaction to it has been favorable. Therefore, it may be well to conclude by reaffirming the opinion that this is a book of high quality, well conceived and competently executed.

TABLES OF THE HYPERGEOMETRIC PROBABILITY DISTRIBUTION by Gerald J. Lieberman and Donald B. Owen. Published by Stanford University Press, Stanford, Calif., 1961, viii-726 pages, $15.00. Reviewed by Leo Katz, Michigan State University.

It has been obvious for some considerable time that it would be very desirable and entirely feasible to prepare an extensive tabulation of the hypergeometric probability distribution,

$$(*)\ p(N, n, k, x) = \binom{N}{n}^{-1} \binom{k}{x} \binom{N-k}{n-x},$$

corresponding to the probability that a sample of n from a lot of N, of which k are defective, contains exactly x defective items. Lieberman and Owen have now produced such a tabulation covering most, if not all, of the range of values in which the function (*) cannot be approximated accurately.

The main table covers almost 700 pages and presents values of $p(N, n, k, x)$ and $P(N, n, k, x) = \Sigma\, p(N, n, k, i)$, where the summation is for all $i \leq x$, accurate to six decimals. Of course, $p(N, n, k, x) = 0$, except where $\max[0, n + k - N] \leq x \leq \min[n, k]$. All non-trivial values of the functions are given for N by units to 50 and then by 10 units to 100. The inclusion of two additional groups illustrates the virtuosity of the computing technique, but does not contribute to the extent of coverage. The first of these appendages covers $N = 1000$ with $n = 500$ only; the second covers $N = 100$ by 100's to 2000, but with $n = \frac{1}{2}N$ and $k = n$ and $(n - 1)$ only. A ten-page appendix gives a table to 15 decimals of log N! for N by units to 2000. This table was employed in the IBM 704 program which produced the main table.

In the introduction, some details are given regarding the computing and checking techniques. It is also explained there that certain symmatries of the function (*) may be used (and were used in the range $N > 25$) to reduce the size of the table. Thus, in the upper range of N, values are read directly only for $x \leq k \leq n \leq \frac{1}{2}N$.

Applications to some simple problems are discussed to illustrate the use of the tables. Binomial, Poisson, and Normal approximations to the hypergeometric function are analyzed with particular attention to the ranges in which each is useful.

The tables are complete for $N \leq 50$. In the range, $50 < N < 100$, it is suggested that the entries N_a, N_1, n_a, and n_1 be employed to read $p(N_a, n_a, k, x)$ and $p(N_1, n_1, k, x)$. N_a is the multiple of 10 next above N and N_1 the similar multiple next below. n_a and n_1 are chosen to make $n_a/N_a = n_1/N_1 = n/N$, approximately. The required value $p(N, n, k, x)$ is obtained by interpolation on N between the two values read from the table. A similar procedure is used for $P(\cdot)$. For $N > 100$, inverse linear interpolation on N between one of the values of N tabluated and $N = \infty$ (the binomial approximation) may be used; the authors claim three-decimal accuracy for this procedure.

The text preceding the tables concludes with a heterogeneous list of formulas on sums of products of binomial coefficients and on sums of certain binomial probabilities. A very useful bibliography of 66 titles is given.

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1961 Edwards Medal Nominations

Nominations are now being received by the Edwards Medal Committee for consideration with respect to the Edwards Medal for 1961.

The purpose of the award, as established by the Board of Directors in 1960, is to honor individuals who have demonstrated outstanding leadership in the American Society for Quality Control and in the practical use of modern methods of quality control, especially by application or organization and administration of quality control work. It is intended to supplement the Shewhart Medal which recognizes theoretical and technical development rather than application and administration accomplishments.

The Medal was struck in honor of Mr. George D. Edwards, the first president of our Society, and the first Medal was awarded to him at San Francisco. The recipients of the Medal have been:

1959—Simon Collier 1960—Wade Richard Weaver

Any member of our Society may submit nominations for candidates for the Edwards Medal Award. However, it is important that complete biographical information be submitted, supporting the nomination. Only then can the Edwards Medal Committee give adequate consideration to the qualifications of your nominee.

Please see that the name of your nominee is forwarded with six (6) copies of the supporting information to the Edwards Medal Committee through your section chairman, or send them direct to the chairman of the Edwards Medal Committee, A. P. Deacon, 36 Bridge Street, Brantford, Ontario, Canada.

To receive consideration the complete information must reach the committee by December 31, 1961.

ANNUAL REPORT
of the
BOARD OF DIRECTORS

American Society for Quality Control, Inc.

Fellow Members:

The past year has been one of decision and action on the part of your Society. Under the able leadership of the Board of Directors and the Executive Committee, the Society has progressed further into a new era; an era of planning, reorganization, and alignment. This, to improve the Society's ability to effectively provide the technical and professional needs of its members; and to provide for better representation and administration.

In behalf of the Board of Directors I wish to highlight some of the more important aspects of the business transacted during the past year; business which would not have been considered without diligent study and preparation by the sponsoring committees.

The Society reorganization plan has continued to progress in consonance with the steps taken last year. The new regions have been established, and the guide lines for election of Regional Directors have been set up.

The evolution of divisions and technical committees continues. The Food and Allied Industries are now represented by the newly formed Food and Allied Industries Division. The Reliability Engineering Technical committee is progressing well.

The new sections in our midst are, "The Mansfield Section," "The Radford-Roanoke Section," "The Central Arkansas Section," "The Merrimack Valley Section," and "The Peoria Section," making a total of 114 sections. The former Joplin Section is now know as the Joplin-Springfield Section.

Our membership as of June, stands at 13,603, a growth of 1,500 members over last year.

Long term efforts to improve our Society publication, *Industrial Quality Control* are paying off. The magazine now boasts 56 pages a month, an increase of eight pages of editorial content. Our new advertising policy has also strengthened our position and we are enjoying a more favorable reception from our potential advertising sources.

We regretfully note that Mason Wescott has tendered his resignation as Chairman of our Editorial Board following many years of enthusiastic and excellent work. He will be sorely missed. He will be succeeded by an outstanding and very capable exponent of quality control and of *Industrial Quality Control*, Irving W. Burr.

A serious study of the feasibility of the Society's owning their own building was accomplished during the year. After all factors had been thoroughly examined, including cost studies for various sections of the country, such action at this time was not considered to be in the best interest of the Society. Further studies have been assigned to the long range planning committee.

The Society Awards program has been revised to add further dignity and honor to the awardees. The Brumbaugh Award will be acknowledged through the presentation of a plaque rather than a modest cash award. The other major addition to the awards program was the establishment of an awards convocation. This will be held as a regular general assembly session of the annual convention.

The A.S.Q.C. Education and Training Institute has been very active during it's first year. It has conducted three management seminars and has prepared a Quality Control Engineering course for presentation this summer.

A.S.Q.C. has been well represented, through professor Paul Clifford's participation in the "Continental Classroom" TV production.

A group life insurance plan has been approved for presentation to the Society members. Participation in the A.S.Q.C. group sickness and hospitalization plan is good.

As you can readily see, the Society is advancing steadily. The Board of Directors wish to express appreciation for the excellent contribution of the Society's Headquarters staff for the administration of Society activities. Looking ahead I can see nothing but continued success for our Society under its new leadership.

Activities of Committees Reporting to the President

The Long Range Planning Committee under the chairmanship of Leon Bass met three times during the past year. Much progress has been made in establishing basic planning objectives and priorities important to the increased effectiveness and growth of A.S.Q.C. For obvious reasons, much of the work of this committee cannot be reported until your Board of Directors has had an opportunity to study and act on their reports and recommendations.

The Auditing Committee under the chairmanship of Paul A. Robert continues to operate in a thorough and expedient manner. The 1960-61 audited financial report was accomplished in conjunction with the firm of Ernst and Ernst, with the resulting annual audited financial report appearing as part of this annual report.

The Shewhart Medal Committee under the chairmanship of Rupert Gause has upheld the high standards of the Society in the selection of the 1960 SHEWHART medalist. Appropriate honors were awarded the medalist during the convention, banquet, and awards convocation. His paper appeared in *I.Q.C.*

The Brumbaugh Award Committee chairman Cuyler J. Hawkes has reported on the excellent deliberations of the BRUMBAUGH awardee for 1960. The awardee was introduced during the annual banquet and awards convocation, and given a distinctive plaque.

The Edwards Medal Committee chairman W. R. Purcell has reported the selection of an outstanding member of the Society. This distinctive award was presented during appropriate ceremonies as a part of the annual banquet, with further recognition at the awards convocation.

The Constitution and By-Laws Committee continues to work diligently and successfully in providing our Board of Directors with proposed revisions to the Society's basic law. This will result in continued improvement and maturity in the administration and execution of Society governmental affairs. The Chairman, Mr. George Edwards, continues to devote a tremendous amount of personal effort to this program and therefore is contributing much to the rapid and successful improvements which are being secured.

The Financial Advisory Committee continues to be successful in the administration of the Society's securities program. Chairman Wade Weaver and his committee are very thorough, and effective in continuing the growth of the Society's investment program, and in providing excellent mature judgment and advice for the consideration of the Board of Directors on all other appropriate matters.

The Nominating Committee under the chairmanship of Mr. C. E. Fisher provided a timely and excellent selection of nominees for national office for 1961-62. Mr. Fisher has also served as Parliamentarian during Board meetings, and is to be commended for his excellent service.

The Committee on Government Relations under the chairmanship of Mr. W. M. Davis began operations during this year. The purpose of the committee is to provide plans and recommendations to the Board which will result in close coordination between government agencies and the Society; and to provide channels of communication wherein your Society can provide aid to appropriate government agencies on matters pertaining to quality control. Assistance has already been provided to one government agency with regards to personnel classifications.

The Redistricting Committee. The recommendations of chairman Fisher's committee were well presented, and were accepted by the Board at its meeting of Feb. 24, 1961.

Your president believes that the Society is most fortunate in having outstanding committee members and chairmen. Each of them have been most active during the past year, and the results have been fruitful to the growth of A.S.Q.C.

Dallas, Texas
June 30, 1961

For the Board of Directors
J. Y. McClure, Chairman

Report of the Executive Secretary

Membership in the Society continues its steady annual growth since its formation in 1946. As of June 30, 1961 it reached a new high of 13,603 (see Exhibit A). The net gain in membership over June 30, 1960 is 1,500, almost double the net gain for last year. The percentage net gain is 11.0%, the highest in the last six years. This reflects the new record high percentages of renewals, 84.4%, another new high in the history of the Society. We hope to continue this improved renewal rate through improved services to members.

1960-1961 Membership Breakdown

Associate Member	1,400	Renewals	10,224
Member	9,985	New Members	3,379
Senior Member	1,983		
Fellow	235	Total	13,603
Total	13,603		
Enrolled Students	134		

The complete membership report as of June 30, 1961 is attached as Exhibit B. Since the last annual report, the following new sections have come into being:

Sections	Charter No.
Mansfield (Ohio)	115
Radford-Roanoke (Virginia)	116
Central Arkansas (Arkansas)	117
Merrimack Valley (Massachusetts)	118
Peoria (Illinois)	119

Currently there are 114 active sections of the Society.

We wish to thank the sections of the Society in cooperating in the direct collection of dues by the headquarters office. This participation has enabled us to utilize the most economical and modern procedures in processing renewals and new members. All domestic sections are now participating in this procedure. Again this coming year we propose to furnish all participating sections with lists of their non-renewing members in August, thus permitting their Membership Committees to contact their un-renewed members earlier than in the past to aid in rapidly increasing the renewal rate, as renewal rate is the real key to Society growth. We propose to furnish each section with a list of paid members in October, so that by comparing this list with the list as of June 30, the number of members still un-renewed can be noted. This will enable earlier working on maintaining section membership.

Section Development Committee — This committee has continued its activities regarding aid to sections in difficulty. During the year 15 sections were serviced in varying degree with most gratifying results for the Society. In addition to this primary function, the Committee was advised of new groups forming into sections with the result that the Section Development Committee was able to aid in their formation and to indicate procedures which increased the chance of survival of these new groups. H. D. Birch was chairman.

Membership Committee — The Committee has sent follow-up letters of invitation to membership, to non-members registering

Exhibit A — Record of Membership Growth

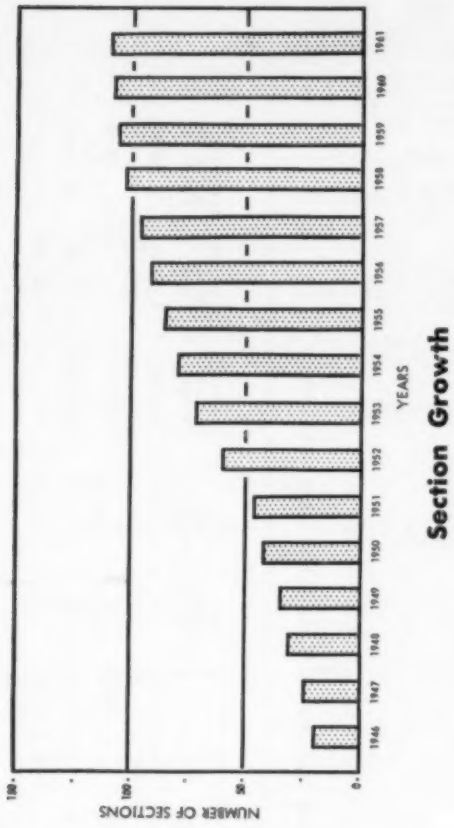
Date	Members	Percent Renewals	Net Gain	Percent Gain	New Members	Active Sections
June 30, 1947	1,926				1,926	25
June 30, 1948	2,102	*	176	9.1	*	31
June 30, 1949	2,638	75.2	536	25.5	1,058	35
June 30, 1950	3,510	76.7	872	33.1	1,489	42
June 30, 1951	4,245	80.5	735	20.9	1,422	48
June 30, 1952	6,109	81.2	1,864	44.0	2,669	60
June 30, 1953	7,430	75.0	1,321	21.6	2,846	71
June 30, 1954	8,548	77.5	1,118	15.1	2,798	80
June 30, 1955	8,780	74.7	232	2.7	2,399	86
June 30, 1956	9,673	78.6	891	10.3	2,781	92
June 30, 1957	10,497	78.3	824	8.5	2,924	97
June 30, 1958	11,063	79.2	566	5.4	2,751	102
June 30, 1959	11,310	79.6	247	2.2	2,510	107
June 30, 1960	12,103	83.5	791	7.0	2,652	109
June 30, 1961	13,603	84.4	1,500	11.0	3,379	114

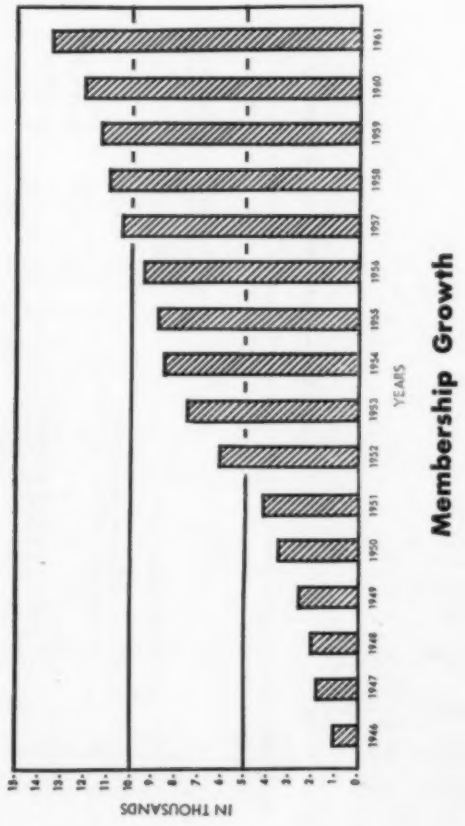
*No record

Exhibit B — Membership Report

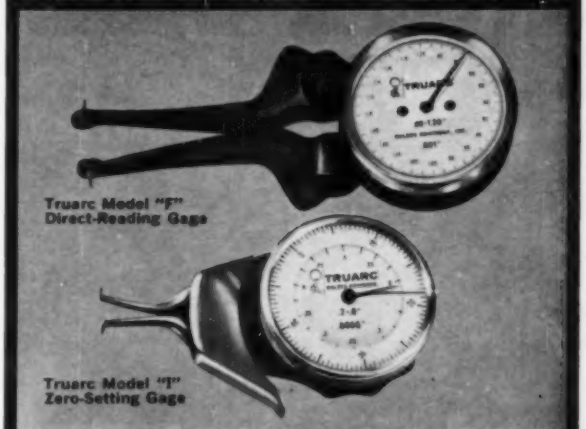
Dist. & Code Nos.	Membership June 30, 1960	Membership June 30, 1961	Percent of June 30, 1960	Renewing Members	Percent Renewals	New Members	Percent New Members
0100 Boston	403	504	125.0	358	88.8	146	36.2
0101 Buzzards Bay	22	18	81.8	17	77.2	*	4.5
0102 Merrimack Valley		19				19	
0103 Hartford	131	159	121.3	113	86.2	46	35.1
0104 New Hampshire	46	60	130.4	39	84.7	21	45.6
0105 New Haven	66	71	107.5	56	84.8	15	22.7
0106 Pittsfield	148	171	115.5	124	83.7	47	31.7
0107 Rhode Island	86	94	109.3	70	81.3	24	27.9
0108 So. Connecticut	136	173	127.2	120	88.2	53	38.9
0109 Western Mass.	62	72	116.1	57	91.9	15	24.1
0110 Worcester	62	58	93.5	52	83.8	6	9.6
DISTRICT 1 TOTALS	1,162	1,399	120.3	1,006	86.5	393	33.8
0200 Albany	85	82	96.4	69	81.1	13	15.2
0201 Buffalo	107	123	114.9	91	85.0	32	29.9
0202 Corning-Elmira	85	78	91.7	70	82.3	8	9.4
0203 Mid-Hudson	117	119	101.7	98	83.7	21	17.9
0204 Rochester	159	192	120.7	148	93.0	44	27.6
0205 Binghamton	117	128	109.4	106	90.5	22	18.8
0206 Syracuse	147	151	102.7	130	88.4	21	14.2
0207 Utica	54	45	83.3	36	66.6	9	16.6
DISTRICT 2 TOTALS	871	918	105.3	748	85.8	170	19.5
0300 Metropolitan	888	1,011	113.8	796	89.6	215	24.2
0400 Hamilton	72	54	75.0	53	73.6	1	1.3
0401 Montreal	209	222	106.2	169	80.8	53	25.3
0402 Toronto	134	159	118.6	118	88.0	41	30.5
0403 Western Ontario	61	59	96.7	48	78.6	11	18.0
0404 Windsor	58	57	98.2	47	81.0	10	17.2
DISTRICT 4 TOTALS	534	551	103.1	435	81.4	116	21.7
0500 Allentown-Bethlehem	147	161	109.5	113	76.8	48	32.6
0501 Danville-Sunbury	29	28	96.5	23	79.3	5	17.2
0502 Erie	45	55	122.2	44	97.7	11	24.4
0503 Harrisburg	127	151	118.8	106	83.4	45	35.4
0504 Lansdale	40	40	100.0	34	85.0	6	15.0
0505 Philadelphia	319	374	117.2	290	90.0	84	26.3
0506 Pittsburgh	147	151	102.7	126	85.7	25	17.0
0507 Scranton-Wilkes Barre	42	49	116.6	35	83.3	14	33.3
0508 Trenton	33	32	96.9	28	84.8	4	12.1
DISTRICT 5 TOTALS	929	1,041	112.0	799	86.0	242	26.0
0600 Baltimore	144	144	100.0	121	84.0	23	15.9
0601 Piedmont	89	97	108.9	76	85.3	21	23.5
0602 Delaware	72	69	95.8	63	87.5	6	8.3
0603 Richmond, Va.	55	64	116.3	56	101.8	8	14.5
0604 Washington	121	165	136.3	120	99.1	45	37.1
0605 Cumberland	30	33	110.0	24	80.0	9	30.0
0606 Radford-Roanoke	11	50	454.5	11	100.0	39	354.5
DISTRICT 6 TOTALS	522	622	119.1	471	90.2	151	28.9
0700 Cleveland	259	262	101.1	228	88.0	34	13.1
0800 Cincinnati	168	148	89.1	136	81.9	12	7.2
0801 Columbus	102	91	89.2	70	68.6	21	20.5
0802 Dayton	98	111	113.2	89	90.8	22	22.4
0803 Parkersburg	39	29	74.3	25	64.1	4	10.2
0804 Toledo	69	76	110.1	63	91.3	13	18.8
0805 Youngstown	66	58	87.8	47	71.2	11	16.6
0806 Charleston	69	61	88.4	52	75.3	9	13.0
0807 Hamilton-Middletown	65	68	104.6	49	75.3	19	29.2
0808 Lima	124	137	110.4	96	77.4	41	33.0
0809 Lexington, Ky.	57	54	94.7	44	77.1	10	17.5
0810 Akron-Canton	122	132	108.1	101	82.7	31	25.4
0811 Mansfield		69		15		54	
DISTRICT 8 TOTALS	977	1,034	105.8	787	80.5	247	25.2
0900 Evansville-Owensboro	49	44	89.7	37	75.5	7	14.2
0901 Grand Rapids	29	32	110.3	27	93.1	5	17.2
0902 Greater Muskegon	50	67	134.0	44	88.0	23	46.0
0903 Indianapolis	165	150	90.9	133	80.6	17	10.3
0904 Muncie	31	33	106.4	30	96.7	3	9.6
0905 Northeast Indiana	46	38	82.6	36	78.2	2	4.3
0906 So. Bend-Mishawauka	91	99	108.7	75	82.4	24	26.3
0907 Richmond, Indiana	100	70	70.0	51	51.0	19	19.0
0908 Btl. Crk.-Kal.	58	66	113.7	48	82.7	18	31.0
DISTRICT 9 TOTALS	619	599	96.7	481	77.7	118	19.0
1000 Greater Detroit	487	551	113.1	405	83.1	146	29.9
1100 Chicago	488	513	105.1	422	86.4	91	18.6
1200 Central Illinois	34	43	126.4	30	88.2	13	38.2
1201 Iowa	121	143	118.1	110	90.9	33	27.2
1202 Milwaukee	202	210	103.9	178	88.1	32	15.8
1203 Minnesota	263	272	103.4	233	88.5	39	14.8
1204 Racine	41	39	95.1	30	73.1	9	21.9
1205 Rockford	44	56	127.2	39	88.6	17	38.6
1206 Winnebago	60	60	100.0	49	81.6	11	18.3
1207 Kankakee-Joliet	36	40	111.1	32	88.8	8	22.2
1208 St. Charles	102	121	118.6	95	93.1	26	25.4
1209 Southern Illinois	43	36	83.7	31	72.0	5	11.6
1211 Peoria		57				57	
DISTRICT 12 TOTALS	946	1,077	113.8	827	87.4	250	26.4
1300 Denver	57	97	170.1	49	85.9	48	84.2
1301 Kansas City	112	120	107.1	94	83.9	26	23.2
1302 Omaha-Lincoln	48	45	93.7	40	83.2	5	10.4
1303 St. Louis	139	136	97.8	109	78.4	27	19.4
1304 Wichita	66	75	113.6	51	77.2	24	36.3
1305 Tulsa	70	47	67.1	35	50.0	12	17.1
1306 Joplin	30	28	93.3	23	76.6	5	16.6
1307 Oklahoma City	66	57	86.3	42	63.6	15	22.7
DISTRICT 13 TOTALS	588	605	102.8	443	75.3	162	27.5
1400 Albuquerque	127	134	105.5	99	77.9	35	27.5
1402 Dallas-Fort Worth	217	212	97.6	143	65.8	69	31.7
1403 Mexico City	66	74	112.1	57	86.3	17	25.7
1404 San Antonio	30	29	96.6	22	73.3	7	23.3
1405 South Texas	97	101	104.1	78	80.4	23	23.7
1406 Waco	22	30	136.3	14	63.6	16	72.7
1407 Central Arkansas		37		1		36	
DISTRICT 14 TOTALS	559	617	110.3	414	74.0	203	36.3
1500 Birmingham	29	36	124.1	27	93.1	9	31.0
1501 Chattanooga	30	36	120.0	26	86.6	10	33.3
1502 Georgia	54	59	109.2	44	81.4	15	27.7
1503 Huntsville	45	48	106.6	42	93.3	6	13.3
1504 Louisville	79	81	102.5	69	87.3	12	15.1
1505 Memphis	38	42	110.5	31	81.5	11	28.9
1506 Tennessee	33	42	127.2	28	84.8	14	42.4
1507 Pensacola-Mobile	68	63	92.6	45	66.1	18	26.4
1508 St. Petersburg-Tampa	63	73	115.8	55	87.3	18	28.5
1509 Orlando-Cape Can.	52	53	101.9	46	88.4	7	13.4
1510 Northeast Tennessee	77	101	131.1	68	88.3	33	42.8
DISTRICT 15 TOTALS	568	634	111.6	481	84.6	153	26.9
1601 Los Angeles	478	711	148.7	437	91.4	274	57.3
1602 Santa Maria-Van.	27	34	125.9	19	70.3	15	55.5
1603 Orange Empire	100	136	136.0	88	88.0	48	48.0
1604 San Bernardino	148	167	112.8	115	77.7	52	35.1
1605 San Diego	152	161	105.9	124	81.5	37	24.3
1606 Tucson	45	34	75.5	23	51.1	11	24.4
1609 Phoenix	59	66	111.8	50	84.7	16	27.1
DISTRICT 16 TOTALS	1,009	1,309	129.7	856	84.8	453	44.8
1700 Japan	67	63	94.0	54	80.5	9	13.4
1701 Portland	45	48	106.6	39	86.6	9	20.0
1702 Salt Lake City	44	56	127.2	36	81.8	20	45.4
1703 San Francisco	252	313	124.2	231	91.6	82	32.5
1704 Seattle	91	108	118.6	74	81.3	34	37.3
1705 Sacramento	66	111	168.1	68	103.0	43	65.1
DISTRICT 17 TOTALS	565	699	123.7	502	88.8	197	34.8
2500 Chapter #1	132	161	121.9	123	93.1	38	28.7
A.S.Q.C. TOTALS	12,103	13,603	112.3	10,224	84.4	3,379	27.9

Exhibit C





NEW FROM WALDES! TRUARC DIAL-INDICATOR GROOVE AND BORE GAGES



Measure inside diameters .20" to 3.0"
Four direct-reading models available

Truarc dial-indicator gages are designed to provide an accurate, economical means for measuring the I.D. of bores and housings, retaining ring grooves, O-ring grooves and other internal recesses. Available in five models for different diameters (see chart below), they have shockproof, jeweled movements for accuracy and large, easy-to-read dials with unbreakable crystals.

The four "F" models are direct-reading gages which do not require preliminary setting. Rigid cast arms assure accuracy of measurement and eliminate deflection. The gages have replaceable needle-type contact points.

The Model I-51 is a zero-setting gage with contact points which are an integral part of the locating arms. The arms and actuating lever are made of corrosion-resistant stainless steel.

For complete details, write for Truarc Data Bulletin No. 459-10.

MODEL NO.	DIAMETER RANGE	GRADUATION	REACH	PRICE*
I-51	.20 — .60	.0005	13/16	$58.50
F-166	.40 — .80	.001	2 - 3/8	$35.00
F-266	.80 — 1.20	.001	2 - 3/8	$35.00
F-177	1.00 — 2.00	.0025	2 - 3/8	$35.00
F-277	2.00 — 3.00	.0025	2 - 3/8	$35.00

Price includes standard contact points, fitted wooden case. All "F" models come with angled screw driver or wrench for adjusting or replacing contact points.

© 1961 Waldes Kohinoor, Inc.

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WALDES TRUARC® RETAINING RINGS

WALDES KOHINOOR, INC.
47-16 Austel Place, Long Island City 1, N. Y.

Exhibit D — Comparative Balance Sheets, June 30, 1961, and June 30, 1960

ASSETS

	1961		1960	
Current Assets				
Office cash funds		$ 290.00		$ 290.00
Demand deposits:				
General operations	$ 16,588.36		$ 29,686.28	
Securities operations	1,131.94	17,720.30	1,137.44	30,823.72
Time deposits:				
General operations	$ 53,544.84		$ 22,533.90	
Brumbaugh Award Fund	2,640.38		2,175.22	
Shewhart Medal Fund	430.57		712.05	
Edwards Medal Fund	352.84	56,968.63	117.40	25,538.57
Accounts receivable		7,057.26		1,738.28
Interest accrued on securities		463.61		449.24
Advances and deposits		2,336.34		1,839.56
Inventories at nominal amounts:				
Back issues and publications	$ 1.00		$ 1.00	
Stationery and supplies	1.00	2.00	1.00	2.00
TOTAL CURRENT ASSETS		$ 84,838.14		$ 60,681.47
Securities—at cost (quoted market value 1961—$135,590.00; 1960—$122,324.45)				
Fixed income:				
United States Treasury bonds	$ 23,890.36		$ 23,010.98	
Other bonds	29,643.74		29,643.74	
Preferred stocks	6,516.25		5,486.25	
	$ 60,050.35		$ 58,140.97	
Equities	45,761.39	105,811.74	44,144.33	102,285.30
Furniture and Equipment—at nominal amount		1.00		1.00
Deferred Charges		5,634.63		7,030.79
		$196,285.51		$169,998.56

LIABILITIES

		1961		1960
Current Liabilities				
Accounts payable		$ 9,596.97		$ 5,770.20
Pay roll taxes and taxes withheld from employees		1,236.70		1,057.32
Sections allotment		17,301.00		13,059.00
Divisions dues		2,237.00		1,754.00
TOTAL CURRENT LIABILITIES		$ 30,393.67		$ 21,640.52
Deferred Income				
Dues collected in advance	$ 51,551.00		$ 40,464.00	
Less sections allotment transferred to current liabilities	17,301.00		13,059.00	
	$ 34,250.00		$ 27,405.00	
Library subscriptions unearned	8,540.00		7,660.00	
Advertising billings unearned	2,524.50	45,314.50		35,065.00
Reserves				
For Capital Equipment	$ 401.68		$ 1.68	
For Education	6,000.00		3,300.00	
Brumbaugh Award Fund	2,640.38		2,175.22	
Shewhart Medal Fund	430.57		712.05	
Edwards Medal Fund	352.84	9,825.47	117.40	6,306.35
Net Worth		110,751.87		106,986.69
		$196,285.51		$169,998.56

Exhibit E — Statement of Changes in Reserves and Net Worth, Year Ended June 30, 1961

	NET WORTH				RESERVES				
	General Operations	Convention Operations	Securities Operations	Total	For Capital Equipment	For Education	Brumbaugh Award Fund	Shewhart Medal Fund	Edwards Medal Fund
Balance at July 1, 1960	($2,323.67)	$ 5,438.37	$103,871.98	$106,986.68	$ 1.68	$3,300.00	$2,175.22	$ 712.05	$ 117.40
Add:									
Excess of income over expense	7,939.57		3,535.31	11,474.88			465.16		235.44
Transfer from General Operations					400.00	2,700.00			
	$ 5,615.90	$ 5,438.37	$107,407.29	$118,461.56	$ 401.68	$6,000.00	$2,640.38	$ 712.05	$ 352.84
Deduct:									
Excess of expense over income		$ 4,609.69		$ 4,609.69				$ 281.48	
Transfer to Reserve for Education	$ 2,700.00			2,700.00					
Transfer to Reserve for Capital Equipment	400.00			400.00					
	$ 3,100.00	$ 4,609.69		$ 7,709.69				$ 281.48	
BALANCE AT JUNE 30, 1961	$ 2,515.90	$ 828.68	$107,407.29	$110,751.87	$ 401.68	$6,000.00	$2,640.38	$ 430.57	$ 352.84

( ) Indicates deficiency in assets

for various regional conferences and area meetings. Although the problem of increased membership is largely a matter of local section effort, the Committee has rendered aid to any desiring sections who have sent inquiries about how membership may be increased. Chairman was W. E. Barker.

Student Branch Committee — The Committee has devoted its effort to promoting the interest of students in quality control at colleges and universities. It has encouraged the scheduling of a college night as a section program, and has urged student chapters of existing scientific societies on college campuses to include quality control programs as part of their regular activities. Dr. Max E. Astrachan served as committee chairman.

Milwaukee, Wisconsin
June 30, 1961

David S. Chambers
Executive Secretary

Report of the Treasurer

The Mid Year and Year End budget review was favorable considering the circumstances surrounding the Society operations and particularly the uncertainty of forecasting of Convention and Exhibit Finances.

Considerable progress has been made in the preparation of the Financial Procedures Manual, particularly through the efforts of George Foster and the counsel received on the earlier chapters from the Auditing Committee will document the established accepted accounting practices now followed by the Society which facilitate the annual audit and will provide a means whereby the officers and Board of Directors of the Society, as well as other interested parties, can familiarize themselves with the Society's accounting procedures.

The Monthly Financial Reports prepared for the Board of Directors & Society officers have indicated a solvent condition throughout the year with a net favorable balance at the year's end. The excellent membership renewals made a significant contribution to this favorable result. Direct collection of dues has been of significant help in achieving the high rate of renewals. In addition, a change on January 1 in the Advertising rates for *Industrial Quality Control* helped this source of income even though the year's goal was not attained.

The shift in printer from Cuneo Press to Publishers Printing Company produced approximately a $7,000 saving during this year while still permitting a 20 percent increase in the size of *Industrial Quality Control*. This expanded content has been well received by the members.

For the first time, detailed information on the Section and Division Financial Status has been made available periodically to the Board of Directors. In addition, the National Office has offered accounting services to the various Divisions of the Society in the interest of uniformity to further extend the services of the membership.

The operations for the year are presented in the following exhibits: Exhibit D, Comparative Balance Sheet; Exhibit E, Statement of Changes in Net Worth and Reserve; Exhibit F, Statement of Income and Expenses; Exhibit G, Statements of Income and Expense—Award Funds; Exhibit H, Graphically presents the Per Capita Income and Expenses reported in Exhibit F.

Assets of the Divisions as reported by their respective treasurer's as of June 30, 1961 are as follows: Administrative Applications, $4,996.09; Aircraft and Missile, $4,549.51; Automotive, $3,093.99; Chemical, $9,126.11; Electronics, $6,393.70; Textile and Needle Trades, $2,134.81; Food and Allied Industries, $171.81.

Binghamton, New York
June 30, 1961

Rocco L. Fiaschetti
Treasurer

Exhibit F — STATEMENT OF INCOME AND EXPENSE
Year Ended June 30, 1961

General operations:		
Income:		
Membership dues	$151,291.50	
Publications	59,520.82	
Services	5,745.60	
Education and Training Institute	14,537.50	
Miscellaneous	1,200.99	$232,296.41
Operating expenses:		
Publications:		
Printing, mailing, and engraving costs—magazine	$ 48,022.74	
Printing costs—other	3,854.16	
Salaries	20,568.35	
Advertising	7,778.94	
Administrative and sundry	5,125.14	
Printing and mailing—membership roster	916.97	
	$ 86,266.30	
Education and Training Institute	$ 11,842.40	
Executive group expenses	$ 1,471.17	
Executive secretary:		
Salaries	$ 27,524.93	
Pay roll taxes	1,503.02	
Records and services	8,881.38	
Rent and light	5,076.21	
Travel	1,850.85	
Equipment and equip. maintenance	1,918.11	
Printing	8,244.28	
Administrative and sundry	10,438.38	
	$ 65,437.16	
Section allotments	$ 47,587.00	
Chapter appropriation	$ 488.00	
Treasurer:		
Salaries	$ 8,653.38	
Legal and other professional	1,000.00	
Insurance	986.43	
Sundry	625.00	
	$ 11,264.81	224,356.84
EXCESS OF INCOME OVER EXPENSE—GENERAL OPERATIONS		$ 7,939.57
Convention operations:		
Income:		
Registration fees	$ 31,009.48	
Exhibit booth sales	12,650.00	
Transactions sales	10,847.47	
Miscellaneous	2,662.00	$ 57,168.95
Expense:		
Banquet	$ 6,474.01	
Publicity and promotion	12,936.94	
Technical program	4,071.44	
Exhibit expense	7,312.51	
Transactions	4,122.38	
Social program	2,502.96	
General administrative:		
Convention operations $ 13,646.90		
Exhibit operations 10,711.50	24,358.40	61,778.64
EXCESS OF EXPENSE OVER INCOME—CONVENTION OPERATIONS		$ 4,609.69
Securities operations:		
Income:		
Interest earned	$ 1,998.77	
Dividends received	2,442.77	$ 4,441.54
Expense:		
Legal and other professional	$ 300.00	
Investment advisory service	606.23	906.23
EXCESS OF INCOME OVER EXPENSE—SECURITIES OPERATIONS		$ 3,535.31
EXCESS OF INCOME OVER EXPENSE—COMBINED OPERATIONS		$ 6,865.19

Accountants' Report

Audit Committee,
American Society for Quality Control, Inc.,
Milwaukee, Wisconsin

We have examined the balance sheet of American Society for Quality Control, Inc. as of June 30, 1961, and the related statements of income and expense and changes in reserves and net worth for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the accompanying balance sheet and statements of income and expense and changes in reserves and net worth present fairly the financial position of American Society for Quality Control, Inc. at June 30, 1961, and the results of its operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

Milwaukee, Wisconsin
August 16, 1961

Ernst & Ernst

Certification of Auditing Committee

Ernst & Ernst, Certified Public Accountants, were retained to audit the books of the American Society for Quality Control, Inc. Relying on this audit and the certification of Ernst & Ernst, we are of the opinion that the accompanying Balance Sheets and Statements of Income and Expense fairly present the financial position of the Society as of June 30, 1961, and its financial transactions for the fiscal year ending that date.

Auditing Committee
Howard R. Bolton
Blair E. Olmstead
H. George Thompson
T. H. Williams
Paul A. Robert, *Chairman*

Cincinnati, Ohio
August 31, 1961

Exhibit G — STATEMENTS OF INCOME AND EXPENSE—AWARD FUNDS
Year Ended June 30, 1961

BRUMBAUGH AWARD FUND

Income:		
Interest earned		$ 74.33
Contributions		425.00
		$ 499.33
Expense—cost of awards		34.17
EXCESS OF INCOME OVER EXPENSE		$ 465.16

SHEWHART MEDAL FUND

Income:		
Interest earned		$ 18.26
Contributions		75.00
		$ 93.26
Expense—cost of medals		374.74
EXCESS OF EXPENSE OVER INCOME		$ 281.48

EDWARDS MEDAL FUND

Income:		
Interest earned		$ 7.61
Contributions		465.00
		$ 472.61
Expense—cost of medals		237.17
EXCESS OF INCOME OVER EXPENSE		$ 235.44

Exhibit H—Per Capita* Income and Expenses

Based on membership of 13,603 at June 30, 1961

Report of the Editorial Board

It is the function of the Editorial Board to have operating supervision of *Industrial Quality Control* and all other technical publications of the Society.

Data on Volume XVII, Issues 1-12 Inclusive

Volume XVII consisted of 688 pages plus 48 cover pages. Of the 688 pages available for editorial copy, 574, or about 83 percent were used for this purpose; the remaining 17 percent were paid ads. Of the 48 cover pages, 36 were for paid ads, 12 for front covers.

In these 12 issues a total of 67 contributed papers were published, averaging 3.4 pages per paper and ranging from 1 to 7 pages in length. Percentagewise these 574 pages were distributed as follows:

1. Contributed papers	39.4%
2. Section, Division, Personal News Item	21.2%
3. Departmental Copy	13.1%
4. Miscellaneous (Masthead and Contents pages, Editorials, ASQC Convention and other Publicity, Stock Lists, Annual Reports, etc.)	26.3%
	100.0%

Contributed papers can be classified as follows:

1. General Applications of SQC Methods	8
2. Special Applications of SQC Methods	12
3. General Interest	15
4. Technical	17
5. Quality Control-Reliability	15

Increase in Size of IQC

Beginning with the August 1960 issue, the number of pages in *IQC* was increased from the previous 48 pages to 56 pages per regular issue. This increase was authorized by the Board of Directors at the request of the Editorial Board. It may be noted that as a result of this action 26 more contributed papers have appeared in Vol. XVII than were published in Vol. XVI even though the percentage use of space available for editorial copy was slightly less than in Vol. XVI. Readers of *IQC* not only benefit from the broader coverage of more published papers, but the time-lag between acceptance of a manuscript and its ultimate publication has been helpfully reduced by this increase in the space available for accepted papers.

General Publications

General Publication No. 5, "The Power to Detect a Single Slippage and the Probability of a Type 1 Error for the Upper Three-Sigma Limit Control Chart for Number of Defects, No Standard Given" — E. G. Olds and E. B. McCue, was approved for publication by the Editorial Board and published during Vol. XVII. This is the companion study to General Publication No. 4 by the same author.

Editorial Board Changes

The following persons have accepted appointment to the Editorial Board for a five-year term beginning July 1, 1961:

Allen R. Crawford
Fred C. Leone
Mrs. Bessie B. (Day) Mauss

The three men retiring from this Board as of June 30, 1961 are:

Dame S. Hamby, North Carolina State College
Charles R. Hicks, Purdue University
Carl E. Noble, Kimberly Clark Corporation

Change in Editorial Chairman

Dr. Mason E. Wescott, retiring Editorial Chairman of *IQC* as of June 30, 1961 was succeeded as of July 1, 1961 by Dr. Irving W. Burr, Statistical Laboratory, Purdue University. Dr. Burr's remaining term of service on the Editorial Board will be filled by Dr. Wescott.

New Book Reviews Editor

Dr. W. D. Baten, Book Reviews Editor for *IQC* since July 1, 1956 retired June 30, 1961 from this post of service to *IQC* which he has filled so faithfully. He is succeeded by Dr. Charles R. Hicks, Purdue University.

Acknowledgement

Grateful acknowledgment is due the following persons for editorial assistance in reviewing submitted manuscripts in cooperation with the Editorial Board:

Robert M. Berg
Herbert D. Birch
Thomas A. Budne
Ralph D. Humphries
Richard M. Jacobs
Truman L. Koehler
Fred C. Leone
Alfred Lieberman
August B. Mundel
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Ellis R. Ott
Roger S. Pinkham
Warren R. Purcell
Stanley B. Sherwood
H. Mack Traux
Grant Wernimont
Albert W. Wortham
Eugene C. Yehle

The Editorial Board and the Society also acknowledge appreciation to the Department Editors who are serving our journal in the maintenance of departmental activity. The roster of this important part of the editorial staff is regularly listed on the Table of Contents page in each issue of the journal.

ASQC Announces

ADVANCEMENT TO THE GRADE OF SENIOR MEMBER
(as of August 18, 1961)

Banfill, Hugh M., Cornwall, Ont., Canada
Berman, Frank, Brookfield, Ill.
Bunch, George O., Lansing, Ill.
Cheak, Donald L., Indianapolis, Ind.
Cook, Hardy M. Jr., Baltimore, Md.
D'Apice, Anthony J., Trumbull, Conn.
Fischer, Maurice, Binghamton, N.Y.
Frakes, William P., Cuyahoga Falls, Ohio
Gamache, Louis J., Berkeley, Ill.
Hepburn, William J., West Chester, Pa.
Kallet, Fred T., Lincoln Park, N.J.
Lyle, Kenneth S. Jr., Tulsa, Okla.
Riley, Thomas M., Columbus, Nebr.
Sellick, Lawrence A., Ottawa, Ont., Canada
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Snodgrass, David K., Philadelphia, Pa.
Storm, Leo E., New Haven, Conn.
Ueki, Zenzaburo, Nobeoka-shi, Japan

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(as of August 18, 1961)

Godsey, Joseph C., Richmond, Va.
Kern, Jack W., Santa Maria, Cal.
Kierszтyn, Philip A., Richmond, Ind.

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(as of August 18, 1961)

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Carson, Albert R., Fort Worth, Texas
Castle, Dana L., Kingsport, Tenn.
Clark, Leroy T., Fort Worth, Texas
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Colyer, Charles C., Milford, Conn.
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Kambowski, John J. Jr., Rochelle Park, New Jersey
Keleher, Walter F., New York, N.Y.
Kerkhoff, Raymond G., Orlando, Fla.
King, Percy H., Fort Worth, Texas
Konikowski, Michael J., Roanoke, Va.
Kriedeman, Alvin H., Fort Atkinson, Wis.
Le Fave, William L., Peabody, Mass.
Legidakes, C. John., Drexel Hill, Pa.
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McNieve, Cecil J., Whittier, Cal.
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7th ASQC Workshop-Seminar

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January 25 - 26 - 27, 1962

Sheraton-Blackstone Hotel, Chicago, Ill.

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ASQC Institute
Paul C. Clifford, Director

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ASQC Institute
161 West Wisconsin Avenue
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POSITIONS AVAILABLE

QUALITY CONTROL ENGINEER

We need a Quality Control Engineer for the technical staff of our Quality Control Organization. Must have at least 2 years experience in quality control, preferably working with mass production of metal parts, with a B.S. Degree in Engineering. Work will involve process studies, capability analysis, test and inspection specifications. He should have workable knowledge of inspection equipment used for control. Send resume and salary requirements with snapshot to B. F. Frazer, American-Standard Plbg. & Htg. Div., 5801 Mariemont Ave., Cincinnati 27, Ohio.

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NOVEMBER

. . . 7-9—Tenth QC Conference, Tokyo Chamber of Commerce and Industry, 14 Marunouchi 3-chome Chiyoda-ku, Tokyo. Contact Kaoru Ishikawa, The Union of Japanese Scientists and Engineers, 2, Kyobashi 1-chome Chuoku, Tokyo, Japan.

. . . 8-10—First joint national meeting of the Operations Research Society of America and the Institute of Management Sciences, Jack Tar Hotel, San Francisco, Calif. Contact Peter H. Butterfield, Stanford Research Institute, Menlo Park, Calif.

. . . 9-10—Eleventh Annual Conference of the Aircraft and Missile Division, ASQC, Ambassador Hotel, Los Angeles, Calif. Contact Hardy Harris, Publicity Chairman, c/o North American Aviation, Inc., International Airport, Los Angeles 45, Calif.

. . . 10—Sixth Annual All Day Conference on Quality Control and Reliability, Hotel Pick Carter, Cleveland, Ohio, sponsored by the Cleveland Section, ASQC. Contact Donald S. Leckie, Republic Steel Corp., 1517 Republic Bldg., Cleveland, Ohio.

. . . 13-15—Third Annual Seminar on Color and Color Control for the Graphic Arts, (cost is $150), Towne House, Rochester, N.Y., sponsored by the Extended Services Division of Rochester Institute of Technology. Contact Harold M. Kentner, Director of Extended Services, Rochester Institute of Technology, Rochester 8, N.Y.

. . . 13-15—Technical and Operating Conference of Steel Founders' Society of America, Hotel Carter, Cleveland, Ohio. Contact Chal Adams, the Bayless-Kerr Co., Hanna Bldg., Cleveland 15, Ohio.

. 14—Symposium on Electronic Systems Reliability, Linda Hall Library Auditorium, 5109 Cherry St., Kansas City, Mo., sponsored by the Kansas City Section, IRE. Contact Arthur Goldsmith, Wilcox Electric, Kansas City, Mo.

. . . 17—Quality Control Conference, Hotel Burlington, Burlington, Iowa, sponsored by the State University of Iowa Section, ASQC. Contact G. J. Narigon, Iowa State Industries, Box 316, Fort Madison, Iowa.

. . . 18—All Day Conference, Chamber of Commerce, Fort Wayne, Ind., sponsored by Northeastern Indiana Section, ASQC. Contact Arnold Berning, 5510 Alexander Drive, Fort Wayne, Ind.

. . . 17-18—Training Course on EVOLUTIONARY OPERATION, Pick-Congress Hotel, Chicago, Ill., jointly sponsored by the Chemical Division and the Food and Allied Industries Division, ASQC. Contact George Miser, TEE-PAK, Inc., 3520 South Morgan Street, Chicago 9, Ill.

. . . 30-Dec. 2—Thee-day course on Response Surface Methodology, Downtowner Motor Inn, Kingsport, Tenn., co-sponsored by the Chemical Division, ASQC and the Northeast Tennessee Section, ASQC. Contact Dr. E. W. Wilson, Tennessee Eastman Co., Kingsport, Tenn.

JANUARY

. . . 9—Short Course in QC, Jan. 9-Apr. 3, University of Nebraska Medical Campus, Omaha, Nebr., sponsored by the Omaha-Lincoln Section, ASQC, and the Extension Division, University of Nebraska. Contact Niles H. Barnard, 203 Richards Hall, University of Nebraska, Lincoln 8, Nebraska.

. . . 9-11—Eighth National Symposium on Reliability and QC, Statler-Hilton Hotel, Washington, D.C., sponsored by ASQC, IRE, EIA and AIEE. Contact A. R. Park, Mail Stop 729, Westinghouse Electric Corp., P.O. Box 1897, Baltimore 3, Maryland.

Our Ever-Growing Family

With the additions of Radford-Roanoke (Va.), Central Arkansas (Ark.), Merrimack Valley (Mass.), and Peoria (Ill.) the number of sections in the Society is now 119. The Society is proud to extend a most cordial welcome to these sections. Following is a list of their current officers.

116—Radford-Roanoke (1511)
Chairman: Raymond C. Rhodes
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Vice Chairman: James W. Thompson
Electro-Tec Corp.
Blacksburg, Va.
Secretary: Thomas F. Donovan
General Electric Co.
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U.S. Time Corp.
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118—Merrimack Valley (0102)
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Vice Chairman: Maurice H. Braden
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Secretary-Treasurer:
Erich M. Politzer
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Peoria, Ill.

Election Of Regional Directors

The Constitutional amendments recently approved by the membership require the election of all fifteen Regional Directors during the current fiscal year. Each Section plays a vital role in this election and, therefore, should be aware of its responsibilities.

On or before January 1, 1962, each Section should inform the Executive Secretary of its nominations for Regional Director. Those Sections in multi-Section Regions should nominate two candidates, one of whom must be affiliated with a different Section within the Region. For Sections in single-Section Regions, a single nomination is sufficient, in which case the nomination would constitute election as Regional Director. By January 15, 1962, the Executive Secretary will notify all Sections of the eligible nominees.

The ballot indicating the candidate for whom the Section casts its votes must be sent to the Executive Secretary by March 1, 1962. Each Section will have as many votes as it had Corporate members on June 30, 1961, and these votes must be cast as a unit. The Executive Secretary will notify the Sections of the new Regional Directors by March 15, 1962.

To be eligible for the Office of Regional Director, a candidate must be a Fellow or Senior Member and must have been a Corporate member for at least six years. Officers or Directors at-Large may not serve as Regional Directors.

Since this is the first year in which Regional Directors will be elected under the new amendments, length of office for Directors will vary in different Regions. The Directors elected in Regions bearing "odd" serial numbers will serve only one fiscal year. Directors elected in the seven Regions bearing "even" serial numbers will serve for two fiscal years.

Responsibility for the election of Regional Directors rests solely with the Sections. Preparations begun now will insure that nominations reach the Executive Secretary by January 1, 1962.

A. W. Wortham, *Executive Secretary*

. . . 25-27 — Seventh Workshop-Seminar on Management of QC, Sheraton-Blackstone Hotel, Chicago, Ill., sponsored by ASQC, course fee is $125 for non-members and $100 for ASQC members. Contact Seventh ASQC Workshop-Seminar, ASQC Institute, 161 West Wisconsin Ave., Milwaukee 3, Wis.

. . . 27—Eleventh Annual All Day Conference, Sinton Hotel, Cincinnati, Ohio, sponsored by Cincinnati Section, ASQC. Contact Don Fleischel, 2286 Deblin Drive, Cincinnati 32, Ohio.

. . . 27—Sixth Annual Inland Empire QC Conference, California State Polytechnic College, Kellogg Campus, Pomona, Calif. Contact S. Roy Wood, 1305 S. Rimsdale Drive, West Covina, Calif.

. . . 29-Feb. 2—Measurement Short Courses, Arizona State University, Tempe, Ariz. ($200 fee for lecture program and $125 fee for experimental program). Contact Prof. Peter K. Stein, Engineering Center, Arizona State University, Tempe, Ariz.

. . . 30-Feb. 2—Eighteenth Annual Technical Conference, Society of Plastics Engineers, Penn-Sheraton Hotel, Pittsburgh, Pa. Contact SPE, 65 Prospect Street, Stamford, Conn.

FEBRUARY

. . . 7-9—National Winter Convention on Military Electronics, Ambassador Hotel, Los Angeles, Calif., sponsored by IRE. Contact Matthew E. Brady, Technical Program Committee, Institute of Radio Engineers, 1 East 79th St., New York 21, N.Y.

. . . 8-10—Three-day course on the Evaluation and Interpretation of Physical and Chemical Testing Methods, Downtowner Motor Inn, Kingsport, Tenn., co-sponsored by the Chemical Division, ASQC and the Northeast Tennessee Section, ASQC. Contact Stanley A. Murray, Tennessee Eastman Co., Kingsport, Tenn.

. . . 18-22—47th Annual Meeting, Technical Association of the Pulp and Paper Industry, Commodore Hotel, New York City. Contact TAPPI, 360 Lexington Ave., New York 17, N.Y.

. . . 26-Mar. 2—QC Course, American Management Association Academy, Saranac Lake, N.Y. Contact AMA Registrar, 1515 Broadway, New York 36, N.Y.

MARCH

. . . 5-9—Thirteenth Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, Penn-Sheraton Hotel, Pittsburgh, Pa., sponsored by the Analytical Chemistry Group of the Pittsburgh Section, ACS and the Spectroscopy Society of Pittsburgh. Contact Dr. C. F. Glick, Applied Research Laboratory, U.S. Steel Corp., Monroeville, Pa.

. . . 8-9—Middle Atlantic Conference, ASQC, Statler-Hilton Hotel, Washington, D.C. Contact Gilbert L. Maton, John I. Thompson & Co., 1119 22nd St., N.W., Washington 7, D.C.

. . . 17—Annual QC Seminar, sponsored by the Southern Connecticut Section, ASQC, in conjunction with the University of Bridgeport, Bridgeport, Conn. Contact Theodore H. Reuther, Bryant Electric Co., Box D, Barnum Station, Bridgeport, Conn.

. . . 24—Seventh Annual QC Symposium, Dan Rogers Hall, Texas Christian University, sponsored by the Dallas-Fort Worth Section, ASQC. Contact Mark R. Seldon, 810 Cedar Hill, Dallas, Texas.

. . . 27—Rochester QC Conference, University of Rochester, Rochester, N.Y., sponsored by the Rochester Section, ASQC. Contact Wilbur C. Myers, Delco Appliance Division, GMC, 391 Lyell Ave., Rochester, N.Y.

. . . 29-30—Conference, Administrative Applications Division, ASQC, Ecole Polytechnique, University of Montreal, Montreal, Quebec. Contact J. B. Pringle, Bell Telephone Company of Canada, 1050 Beaver Hall Hill, Montreal 1. Que.

APRIL

. . . 11-13—Technical Meeting and Equipment Exposition of the Institute of Environmental Sciences, Sheraton Hotel, Chicago, Ill. Contact H. F. Sander, Executive Secretary, P.O. Box 191, Mt. Prospect, Ill.

. . . 14—Second Annual Forum, Toledo Section, ASQC, Hillcrest Hotel, Toledo, Ohio. Contact T. R. Meyer, Owens-Illinois Glass Co., Box 1035, Toledo 1, Ohio.

. . . 27-28—SQC Conference, Hotel Anthes, Fort Madison, Iowa, sponsored by the State University of Iowa Section, ASQC. Contact G. J. Narigon, Iowa State Industries, Box 316, Fort Madison, Iowa.

CONSULTING SERVICES

Responsibility of the American Society for Quality Control, Inc., for Consulting Services advertising is limited to certification that advertisers hold the grade of membership in the Society stated in their advertisements. Qualification requirements for the several grades of memberships are set forth in the Constitution of the Society. Business card ads are available only to members of the Society—12 insertions $100.00; 6 insertions $65.00.

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